BRICKWORK TESTS.

REPORT ON THE THIRD SERIES OF EXPERIMENTS, by William C. Street [*F.*] and Max. Clarke [*A.*]. With APPENDICES by Professor Unwin [*H.A.*], F.R.S.

Read at the General Meeting of the Royal Institute of British Architects, Monday, 13th December 1897.

THE experiments conducted by the Science Standing Committee to ascertain the average strength of various descriptions of brickwork were completed last spring by the crushing at the West India Docks of twenty short lengths of brick walls, each about 6 ft. high by 27 in. long, and 18 in. thick.* The results, with notes of the condition of the walls under the increasing strains, are given in the tables annexed, which have been prepared by Mr. Street from the notes made by himself and his colleagues, Messrs. Max. Clarke, Matt. Garbutt, and Bernard Dicksee, who, as before, were present at all the crushings, and took the parts described on page 73 of Vol. IV. of the Journal.

The real load exercised by the ram at the several pressures has been calculated from the formula given by Professor Unwin, as described in an appendix to this Report [p. 100]. The pressure gauges used have been tested by the makers, Messrs. Schäffer & Budenberg, but the errors were so little that, for the purposes of comparison with the previous experiments, it has been thought better to adhere to the indicated readings.

The Committee do not propose at present to give any fixed rules based upon the results or information gained by these experiments, as it is hoped that the Council of the Royal Institute will sanction the preparation of a careful analysis of the facts contained in the three Papers, and issue the same in a suitable shape. If this is done, it may be possible to generalise and formulate rules which should govern the use of different kinds of brickwork as the supporting features of the structures erected under our superintendence.

Any member of the Institute may, however, by a study of the tables of results, form his own conclusions as to safe limits ; but it will be of use to the general body that the details shall be arranged and classified by those who have watched the experiments throughout and are acquainted with the particular circumstances connected with the building and crushing of each specimen.

Meanwhile we may be allowed to give a few of the impressions derived.

The resistance of brickwork in lime mortar to crushing would seem to vary to from one-sixth to one-eighth of the resistance offered by the brick itself, while in cement mortar it varies from one-half to one-fifth of that strength. It is obvious that while cement mortar must very materially aid the weaker bricks in their combined strength, it cannot materially affect the ultimate power of resistance in brickwork made of a harder variety.

* For Reports, tables of results, and discussions on the First and Second Series of Experiments, see Journal, Vol. III. 3rd Ser. pp. 333–58 ; Vol. IV. pp. 73–103, 121–28

The compression diagram [p. 99] clearly indicates how the mortar is compressed under the increasing strains. The different specimens in lime mortar and those in cement mortar show comparatively little difference in the respective rates at which the beds were crushed, and the only question was how long the bricks would be able to resist the pressure if the load was increased at these rates. Each specimen gave indications that the bricks were going in detail at various points and heights, until the whole of the mass was sufficiently injured as to cause collapse.

The average thickness of the bricks was $2\frac{3}{4}$ in., and the total thickness of the mortar beds was 6 in., while the compression of the lime mortar beds averaged 1 in., and that of the cement mortar beds about $\frac{1}{3}$ in. This proves that the mortar generally was well crushed and disintegrated long before the final collapse of the several examples of brickwork. The instantaneous photographs also show the mortar flowing out as in a stream or fountain at the moment of collapse.

In dealing with the working load that may be calculated upon, care must be taken not to impose such a load as would materially damage the structure of the brickwork. At one-fifth of the crushing load the compression in lime mortar averaged $\frac{7}{32}$ in. in 6 ft. of brickwork, and in cement mortar it averaged $\frac{5}{32}$ in. Another thing that will have to be remembered is the great difference between dead and live loads. It would have been very interesting if experiments could have been devised to ascertain this difference.

No. 34.—Stock Bricks from Sittingbourne, in Lime Mortar 1 to 2.

Wall 6′ $1\frac{1}{2}$″ high; 28″ × $18\frac{5}{8}$″; sectional area 3·622 sq. ft.
Built 23rd October 1896; crushed 30th March 1897. Age $22\frac{1}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
10.55	8	1·01	·27	—	In bearing.
—	10	1·94	·53	$\frac{1}{32}$	
10.58	13	3·33	·92	$\frac{2}{32}$	Pointing injured by frost spalling.
11.2	18	5·65	1·56	$\frac{3}{32}$	
11.4	22	7·50	2·07	$\frac{4}{32}$	
11.6	30	11·22	3·10	$\frac{5}{32}$	
11.8	40	15·86	4·38	$\frac{6}{32}$	
11.9$\frac{1}{2}$	50	20·50	5·66	$\frac{7}{32}$	
11.11	64	26·99	7·45	$\frac{8}{32}$	
11.12	75	32·10	8·86	$\frac{9}{32}$	
—	80	34·42	9·50	$\frac{10}{32}$	
—	90	39·06	10·79	$\frac{11}{32}$	
11.14	95	41·38	11·42	$\frac{12}{32}$	
—	100	43·70	12·05	$\frac{13}{32}$	
11.15	105	46·02	12·70	—	Slight internal crack heard.
11.15$\frac{1}{2}$	110	48·34	13·34	$\frac{14}{32}$	
—	112	49·27	13·60	$\frac{15}{32}$	
11.16	115	50·66	13·99	$\frac{16}{32}$	E. face of wall cracked at centre of course 8.
—	120	52·98	14·62	—	Internal crack heard.
—	125	55·30	15·26	$\frac{18}{32}$	W. face, small cracks in vertical joints.
11.17	130	57·62	15·90	$\frac{20}{32}$	E. face, crack in course 8 opening.
11.18	135	59·94	16·55	—	E. face, fine crack in courses 6 to 8, $2\frac{1}{2}$″ from N.E. angle.
11.18$\frac{1}{4}$	138	61·33	16·93	$\frac{24}{32}$	E. face cracked at centre from course 6 to 11. Cracking up S. end.
—	142	63·19	17·44	$\frac{28}{32}$	E. face flaking and splitting badly.
					W. face bulging, but fairly sound on surface.
11.22	—	—	—	—	Wall bent towards N.W., and fell. Pressure falling to 125 lbs. See photographs, figs. 1 and 2 [p. 79].
					Mortar set, but still moist.
					Bottom four courses quite sound after fall, save the S.E. corner, which was the first place to fail.

FIG. 1.

FIG. 2.

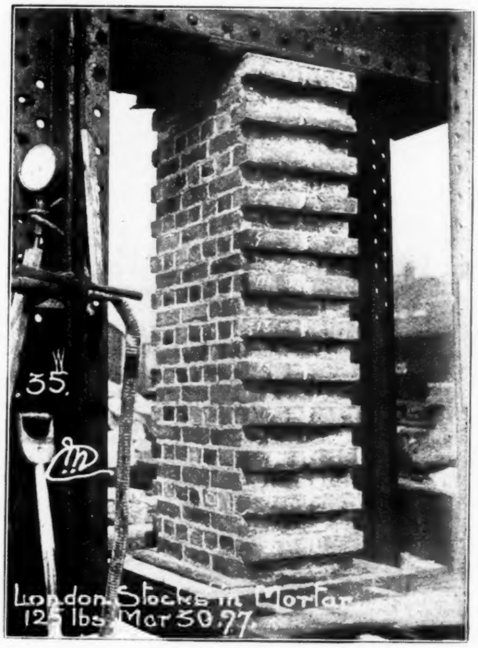


FIG. 3.

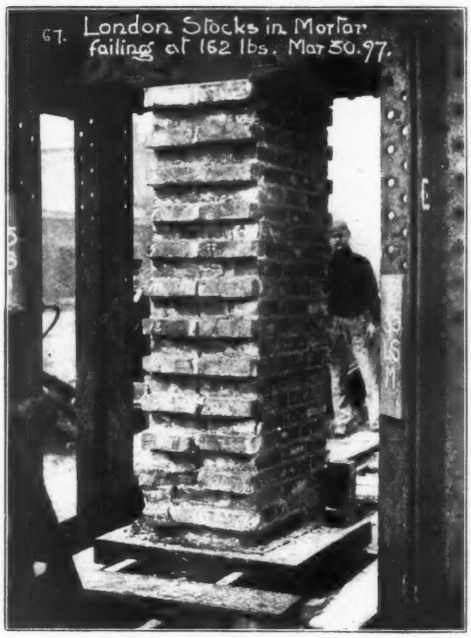


FIG. 4.

If we take a safe load, or one that would not materially damage the structure, as one-fifth of the crushing load, it may be assumed from the results obtained that in lime mortar 1 to 2 Stock brickwork is equal to about $3\frac{1}{2}$ tons, Gault 6 tons, Fletton 6 tons, Leicester Red 9 tons, and Staffordshire Blue 23 tons per square foot. In Portland cement mortar, 1 to 4, Stocks would be equal to about 8 tons, Gaults 10 tons, Flettons 11 tons, Leicester Red 17 tons, and Staffordshire Blue 24 tons per square foot. This is only a general assumption, which requires further consideration.

The influence of form upon strength has to be considered, but under the ordinary or average conditions of practice, the form of brickwork does not appear very greatly to affect the strength, the 18 in. square piers having given approximately similar results per square foot to those obtained from specimens 27 in. by 18 in., and in a building of any height the

No. 35.—Stock Bricks from Sittingbourne, in Lime Mortar 1 to 2.

Wall 6′ 1″ high; $28\frac{1}{4}''$ × $18\frac{5}{8}''$; sectional area 3·654 sq. ft.
Built 23rd October; crushed 30th March. Age $22\frac{4}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
1.5	10	1·94	·53	—	In bearing. Pointing loose by frost.
1.6	13	3·33	·91	$\frac{1}{32}$	
1.7	14	3·79	1·04	$\frac{2}{32}$	
$1.7\frac{1}{2}$	15	4·26	1·16	$\frac{3}{32}$	
$1.8\frac{1}{4}$	17	5·19	1·42	$\frac{4}{32}$	
$1.9\frac{1}{2}$	20	6·58	1·80	$\frac{5}{32}$	Joints spalling.
1.11	26	9·36	2·56	$\frac{6}{32}$	
$1.11\frac{1}{2}$	30	11·22	3·07	$\frac{7}{32}$	
$1.13\frac{3}{4}$	41	16·32	4·47	$\frac{8}{32}$	
1.16	51	20·96	5·74	$\frac{9}{32}$	
1.19	68	28·85	7·89	$\frac{10}{32}$	
1.21	80	34·42	9·42	$\frac{11}{32}$	Slight internal sound.
1.24	95	41·38	11·32	$\frac{12}{32}$	
$1.25\frac{1}{2}$	104	45·56	12·47	$\frac{13}{32}$	
$1.26\frac{1}{2}$	115	50·66	13·86	$\frac{14}{32}$	
$1.27\frac{1}{2}$	120	52·98	14·50	$\frac{15}{32}$	W. face, small crack through course 2.
1.28	125	55·30	15·13	—	See photograph, fig. 3 [p. 79].
1.29	130	57·62	15·77	$\frac{16}{32}$	S. end, crack through course 23.
$1.29\frac{3}{4}$	135	59·94	16·40	$\frac{17}{32}$	
$1.30\frac{1}{2}$	140	62·26	17·04	$\frac{18}{32}$	W. face, cracks in courses 8, 10, and 13.
—	141	62·72	17·16	—	E. face, crack in course 16.
$1.31\frac{1}{4}$	144	64·11	17·54	—	E. face, crack in course 18.
$1.31\frac{1}{2}$	145	64·58	17·67	—	E. face, crack in course 6.
1.32	147	65·50	17·92	$\frac{19}{32}$	E. face, crack in course 17.
$1.32\frac{1}{4}$	150	66·90	18·31	$\frac{20}{32}$	
1.34	155	69·22	18·94	$\frac{21}{32}$	E. face, several cracks at various levels, about $2\frac{1}{2}''$ from toothing on both corners; also several cracks on S. end.
1.35	157	70·15	19·19	—	N. end, course 12 split at centre.
					E. face, courses 12, 16, and 18 split.
1.36	160	71·54	19·57	$\frac{23}{32}$	E. face, many hair cracks, and small fragments of mortar dropping.
					W. face, crack 6″ from S. corner through courses 12 to 19.
					N. end, only the one crack noted at 157 lbs.
—	161	72·00	19·70	$\frac{24}{32}$	
$1.37\frac{1}{2}$	162	72·47	19·83	$\frac{27}{32}$	Wall cracking up and widening to 19″. Pressure falling.
					See photograph, fig. 4 [p. 79].
1.39	—	—	—	$\frac{28}{32}$	E. face, N.E. corner fell out, and fall of whole wall followed.
					Courses 4 to 7 nearly intact after fall. The top seven courses fell solid, but three upper ones were smashed on striking the ground.
					Mortar set, but still damp.

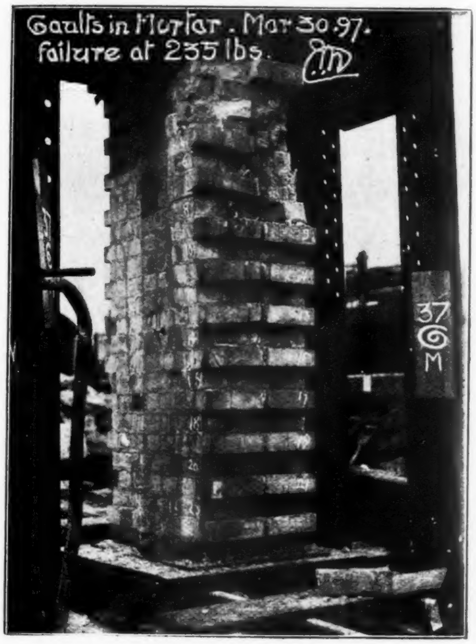


FIG. 5.

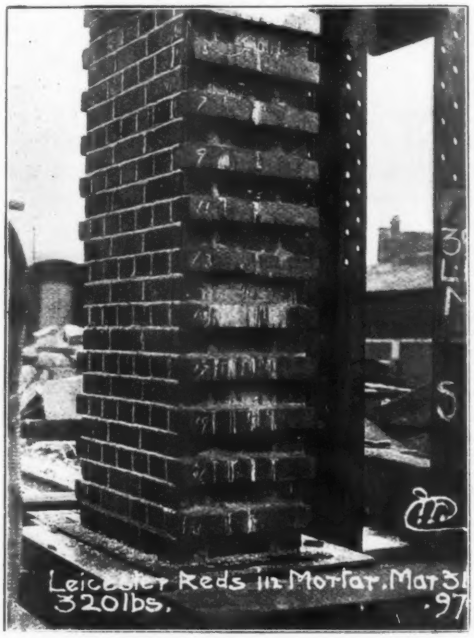


FIG. 6.

FIG. 7.

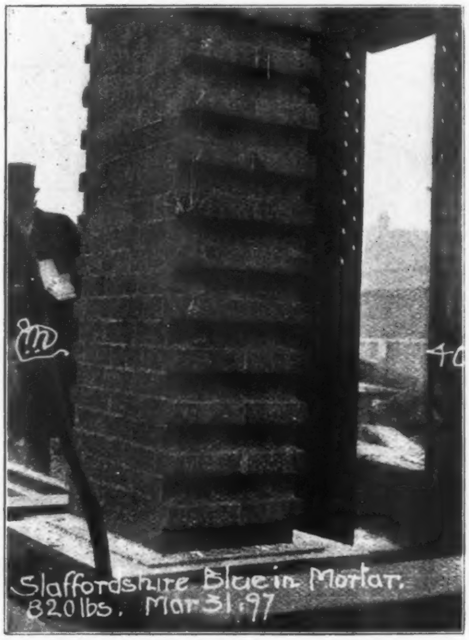


FIG. 8.

total height may be considered as divided by each floor. Otherwise, the effect of a shearing or a bending strain, however introduced, would be fatal to any walls of great height and length.

Another question is that of the effect of age upon the different varieties of brickwork. The specimens marked *a* in the second series were three months old, and all of those in the third series were five months old. Upon inspection of the tables of results it will be seen that, except in the case of blue bricks in cement, those built three months gave very similar results to those built five months. The difference in the case of the blue bricks is partly explained by the fact that the bricks of which the specimens 27 in. by 18 in. were built were from a stronger lot than those of which the 18 in. square were built, the samples from each delivery failing respectively at 779 and 701 tons per square foot.

No. 36.—Gault Bricks from Burham, Kent, in Lime Mortar 1 to 2.

Wall 6′ 0⅞″ high; 27½″ × 18″; sectional area 3·437 sq. ft.
Built 23rd October; crushed 30th March. Age 22$\frac{4}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
2.16½	14	3·79	1·10	—	In bearing.
2.17	15	4·26	1·24	$\frac{1}{32}$	
2.17¾	16	4·72	1·37	$\frac{2}{32}$	
2.18½	20	6·58	1·91	$\frac{3}{32}$	
2.19½	25	8·90	2·59	$\frac{4}{32}$	
2.20½	35	13·54	3·94	$\frac{5}{32}$	
—	47	19·11	5·56	$\frac{6}{32}$	
2.24	70	29·78	8·66	$\frac{7}{32}$	
2.26¼	85	36·74	10·69	$\frac{8}{32}$	
—	104	45·56	14·13	—	E. face, hair crack in course 4, 3″ from S.E. angle.
2.30½	105	46·02	13·39	$\frac{9}{32}$	
2.36½	115	50·66	14·74	$\frac{10}{32}$	
2.39½	125	55·30	16·09	—	W. face, 2 cracks in centre of course 16.
—	138	61·33	17·84	$\frac{11}{32}$	
2.43	140	62·26	18·11	—	Slight sound.
2.45	150	66·90	19·46	$\frac{12}{32}$	
2.45½	155	69·22	20·14	—	W. face, crack in course 8, S.W. angle.
2.47½	165	73·86	21·49	$\frac{13}{32}$	
2.48½	170	76·18	22·16	—	Sharp audible cracks.
—	171	76·64	22·30	—	N. end, 1″ from N.E. angle; crack in overhanging toothing.
					S. end, crack in centre of course 14.
2.49½	175	78·50	22·83	$\frac{14}{32}$	
2.50½	185	83·14	24·19	—	E. face, slight hair crack in course 16, 6″ from S.E. angle.
2.51	190	85·46	24·86	$\frac{15}{32}$	E. face, crack continued down through course 18.
					S. end, cracks in courses 15 to 18.
—	194	87·31	25·40	—	E. face, crack continued up through course 14.
2.52	198	89·17	25·95	$\frac{16}{32}$	E. face, crack in course 10, 4½″ from N.E. angle.
					Audible crack.
2.52½	200	90·10	26·21	—	E. face, hair crack in course 18, 7″ from N.E. angle.
					W. face, cracks spreading and opening.
2.53½	205	92·42	26·89	$\frac{17}{32}$	
2.54	210	94·74	27·56	—	E. face, hair cracks in centre of courses 18 and 20.
—	215	97·06	28·24	$\frac{18}{32}$	E. face, hair crack in course 6, 4½″ from S.E. angle.
—	225	101·70	29·59	$\frac{19}{32}$	N. end, courses 15, 16, and 17 split at centre, and followed by similar split in courses 3 to 6.
					Wall 18¼″ wide.
2.56½	230	104·02	30·26	$\frac{20}{32}$	
2.58	238	107·73	31·34	$\frac{21}{32}$	E. face, five cracks in courses 14 to 18.
					Pressure fell and wall moved, shifting compression gauge. The cracks opened generally, then the S.E. corner split out, and the wall fell.

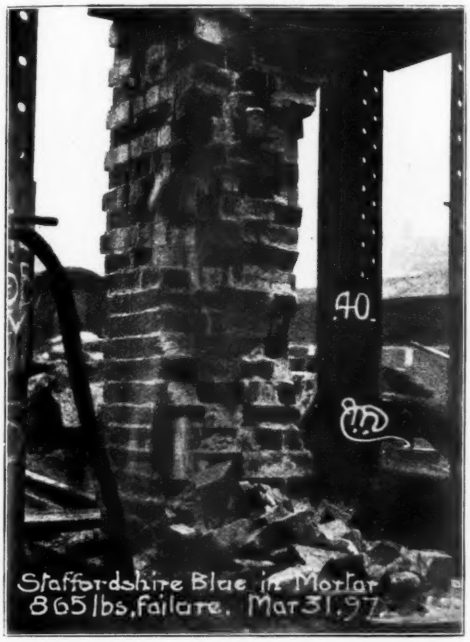


FIG. 9.

FIG. 10.

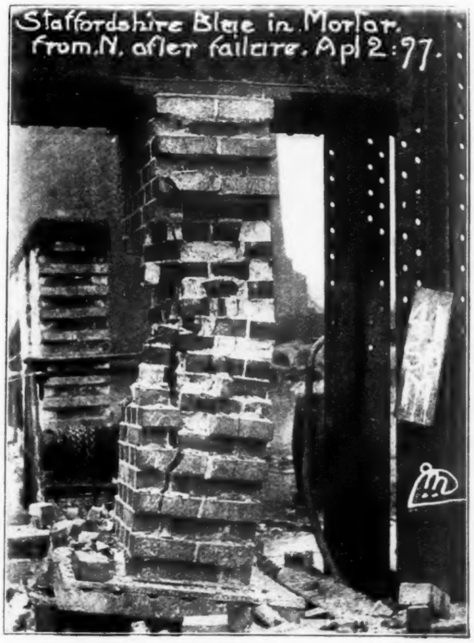


FIG. 11.

FIG. 12.

No. 37.—Gault Bricks from Burham, Kent, in Lime Mortar 1 to 2.

Wall 6′ $0\frac{7}{8}$″ high; $27\frac{1}{2}$″ × 18″; sectional area 3·437 sq. ft.
Built 23rd October; crushed 30th March. Age $22\frac{4}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
3.41	15	4·26	1·24	—	In bearing.
—	19	6·12	1·78	$\frac{1}{32}$	
—	21	7·04	2·05	$\frac{2}{32}$	
$3.42\frac{1}{2}$	25	8·90	2·59	$\frac{3}{32}$	
3.43	30	11·22	3·26	$\frac{4}{32}$	
$3.43\frac{3}{4}$	40	15·86	4·61	$\frac{5}{32}$	
$3.44\frac{1}{4}$	50	20·50	5·96	$\frac{6}{32}$	
3.45	65	27·46	7·99	$\frac{7}{32}$	
3.47	82	35·35	10·29	$\frac{8}{32}$	
3.48	85	36·74	10·69	—	
3.51	100	43·70	12·71	$\frac{9}{32}$	
3.54	118	52·05	15·14	$\frac{10}{32}$	
3.56	130	57·62	16·76	—	E. face, two hair cracks in course 24, next S.E. angle.
3.57	135	59·94	17·44	$\frac{11}{32}$	E. face, the cracks already noticed at bottom of wall passing upwards for 3 courses.
					W. face, flaking centre of top course.
3.59	145	64·58	18·79	$\frac{12}{32}$	N. end, courses 18 to 22 cracked at centre.
4.1	160	71·54	20·81	$\frac{13}{32}$	N. end, crack in centre of course 15.
					W. face, crack in courses 14 to 16, $4\frac{1}{2}$″ from S. corner.
4.2	169	75·72	22·03	$\frac{14}{32}$	S. end, two cracks in centre.
$4.3\frac{1}{2}$	175	78·50	22·84	$\frac{15}{32}$	E. face, crack in course 8, $7\frac{1}{2}$″ from S.E. angle.
$4.4\frac{1}{2}$	180	80·82	23·51	—	W. face, two cracks near bottom, N. angle.
$4.5\frac{1}{2}$	185	83·14	24·18	$\frac{16}{32}$	E. face, courses 20 to 24 cracked at $2\frac{1}{4}$″ from S.E. angle.
4.6	187	84·07	24·46	—	E. face, courses 18 to 20 cracked at $2\frac{1}{4}$″ from N.E. angle, and the crack at centre of N. end opening $\frac{1}{32}$″.
$4.7\frac{1}{2}$	195	87·78	25·54	—	Sounds of internal cracking.
4.8	200	90·10	26·21	—	N. end, centre crack extending to course 14.
$4.8\frac{1}{2}$	205	92·42	26·89	$\frac{17}{32}$	
4·9	210	94·74	27·56	$\frac{18}{32}$	E. face, cracking and flaking at bottom, S.E. angle.
4.10	220	99·38	28·92	$\frac{20}{32}$	W. face, cracked from course 12 to 19, S. angle.
4.11	230	104·02	30·26	—	N. end, centre crack open $\frac{1}{16}$″.
4·12	235	106·34	30·94	$\frac{22}{32}$	E. face, splitting in centre.
—	—	—	—	$\frac{24}{32}$	W. face, cracking in several places. (See photograph, fig. 5.)
					Pressure fell, S.E. corner fell out, next the S.W. corner, and then the whole gave way, the mass falling towards N.
					Mortar set harder than in Nos. 34 and 35, but not quite dry.

No. 38.—Red Bricks from Ellistown, near Leicester, in Lime Mortar 1 to 2.

Wall 6′ 1″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 29th October; crushed 31st March. Age $21\frac{6}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
$10.52\frac{1}{2}$	15	4·26	1·26	—	In bearing.
10.54	20	6·58	1·95	$\frac{1}{32}$	
10.56	40	15·86	4·69	$\frac{2}{32}$	
$10.57\frac{1}{2}$	70	29·78	8·82	$\frac{3}{32}$	
10.58	95	41·38	12·26	$\frac{4}{32}$	
$10.59\frac{1}{2}$	115	50·66	15·01	$\frac{5}{32}$	
$11.0\frac{1}{2}$	128	56·69	16·80	$\frac{6}{32}$	
11.2	139	61·79	18·31	$\frac{7}{32}$	
$11.3\frac{1}{4}$	145	64·58	19·13	$\frac{8}{32}$	
$11.6\frac{1}{2}$	160	71·54	21·20	$\frac{9}{32}$	
11.8	168	75·25	22·30	$\frac{10}{32}$	
11.11	180	80·82	23·95	$\frac{11}{32}$	
11.13	188	84·53	25·04	$\frac{12}{32}$	
11.15	200	90·10	26·70	$\frac{13}{32}$	E. face, bottom course cracked $2\frac{1}{2}$″ from S.E. angle.
					E. face, crack in course 16, 6″ from N.E. angle.
11.18	210	94·74	28·07	$\frac{14}{32}$	E. face, mortar slightly squeezing out.
					E. face, hair crack in course 12, 6″ from S.E. angle.
—	215	97·06	28·76	—	E. face, hair crack in course 14, 6″ from N.E. angle.
11.21	220	99·38	29·44	$\frac{15}{32}$	W. face, small crack at bottom.
11.22	225	101·70	30·13	$\frac{16}{32}$	
11.24	235	106·34	31·51	—	E. face, crack in course 18, $1\frac{1}{2}$″ from N.E. angle.
11.25	240	108·66	32·20	$\frac{17}{32}$	
11.26	245	110·98	32·88	$\frac{18}{32}$	E. face, hair crack in course 14, 6″ from S.E. angle.
11.27	250	113·30	33·57	—	Slight audible crack.

[No. 38 continued on p. 86.

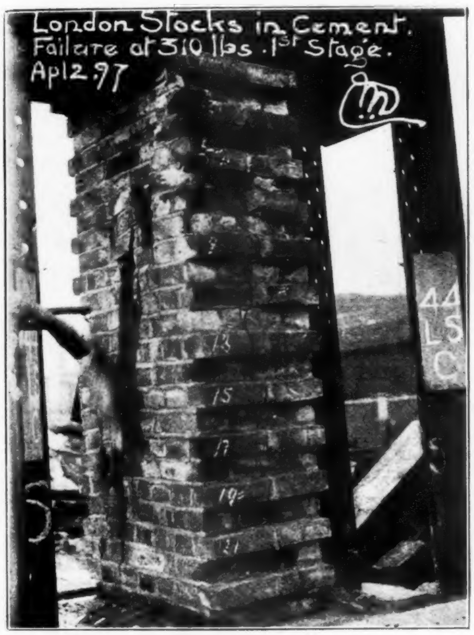


FIG. 13.

FIG. 14.

FIG. 15.

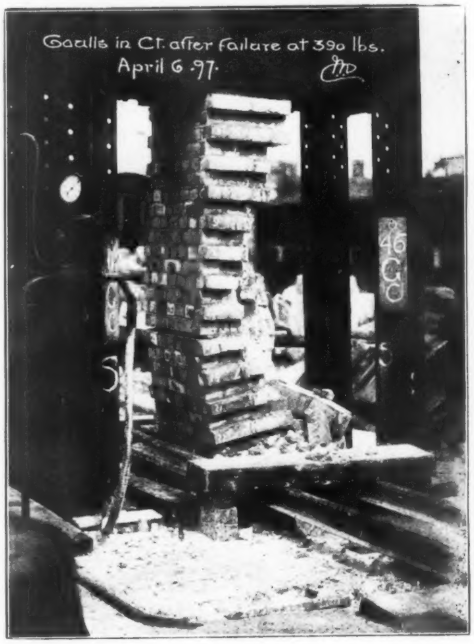


FIG. 16.

No. 38 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
11.28	260	117·94	34·94	$\frac{19}{32}$	W. face, crack in centre of course 18.
					E. face, another crack in course 12, next S.E. angle.
11.30	268	121·65	36·04	$\frac{20}{32}$	
11.30½	270	122·58	36·32	—	At this time the faces of most of the mortar joints on E. face were disintegrated.
11.32½	280	127·22	37·69	$\frac{21}{32}$	N. end, courses 17 and 19 split at centre.
11.34	285	129·54	38·38	$\frac{22}{32}$	E. face, cracks next N.E. angle slightly opening.
11.35	308	140·21	41·54	$\frac{23}{32}$	
11.35¼	310	141·14	41·82	$\frac{24}{32}$	
11.36	320	145·78	43·19	$\frac{26}{32}$	E. face showing serious damage near centre.
					W. face, several detached cracks, courses 17 to 20.
11.38	330	150·42	44·57	$\frac{27}{32}$	Wall bending, convex face to W.
11.39	338	154·13	45·67	$\frac{29}{32}$	
11.39½	340	155·06	45·94	$\frac{30}{32}$	S.E. angle, courses 10 to 23, fell out of wall.
—	—	—	—	1	Pressure fell and wall collapsed, the bottom course alone remaining intact, and very few whole bricks left.
					Mortar well set, but slightly damp.

No. 39.—Red Bricks from Ellistown, near Leicester, in Lime Mortar 1 to 2.

Wall 6′ 1¼″ high; $26\frac{7}{8}'' \times 18''$; sectional area 3·359 sq. ft.

Built 29th October; crushed 31st March. Age $21\frac{6}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
1.18	15	4·26	1·27	—	In bearing.
1.20	20	6·58	1·96	$\frac{1}{32}$	
1.22	30	11·22	3·34	$\frac{2}{32}$	
1.23	40	15·86	4·72	$\frac{3}{32}$	
1.25	64	26·99	8·03	$\frac{4}{32}$	
1.26½	80	34·42	10·24	$\frac{5}{32}$	
1.29¼	103	45·09	13·42	$\frac{6}{32}$	
1.31	117	51·59	15·36	$\frac{7}{32}$	
1.33¾	132	58·55	17·43	$\frac{8}{32}$	
1.36½	142	63·19	18·81	$\frac{9}{32}$	
1.39¼	158	70·61	21·02	$\frac{10}{32}$	
1.40½	169	75·72	22·54	$\frac{11}{32}$	
1.43½	178	79·89	23·78	$\frac{12}{32}$	
1.47	186	83·60	24·89	$\frac{13}{32}$	
1.50½	200	90·10	26·82	$\frac{14}{32}$	No sign of damage.
1.53	215	97·06	28·89	$\frac{15}{32}$	
1.53¼	220	99·38	29·59	—	Audible crack and slight falling of mortar on E. face.
					E. face, cracks in four courses near centre.
					W. face, crack in course 14, 2″ from S.W. angle.
1.55	225	101·70	30·28	$\frac{16}{32}$	N. end, cracks in five courses near centre.
1.55½	230	104·02	30·97	—	W. face, crack in courses 10 to 12; also in courses 4, 14, and 17.
1.56	240	108·66	32·35	$\frac{17}{32}$	E. face, hair crack in course 4, 3″ from S.E. angle.
1.57	250	113·30	33·73	$\frac{18}{32}$	N. end, the crack in centre, noted at 225 lbs., passed up through courses 11 and 10.
					E. face, hair crack in centre of course 2.
					W. face, several continuous cracks, courses 14 to 18.
1.58	260	117·94	35·11	$\frac{19}{32}$	E. face, hair crack in centre of course 20.
					S. end, several cracks in centre.
1.59	275	124·90	37·18	$\frac{20}{32}$	
1.59¼	280	127·22	37·87	$\frac{21}{32}$	
2.0	290	131·86	39·25	$\frac{22}{32}$	E. face, mortar joints crushed at surface in many places.
					W. face, internal crushing heard about course 14.
2.0½	300	136·50	40·64	$\frac{23}{32}$	N. end, long crack in centre opening slightly.
—	305	138·82	41·33	—	W. face, crushing spreading.
2.1	310	141·14	42·02	$\frac{24}{32}$	E. face, many small cracks in courses 11 to 14, within 12″ of N.E. angle.
					N. end, spalling in courses 4 and 6, near N.E. angle.
—	310	141·14	42·02	$\frac{25}{32}$	
2.2½	315	143·46	42·71	$\frac{26}{32}$	
2.3	320	145·78	43·40	$\frac{27}{32}$	E. face, surfaces of joints dropping off. (See photograph, fig. 6, p. 81.)
2.5	330	150·42	44·78	$\frac{28}{32}$	E. face, courses 4 to 6 split at 2″ from N.E. angle.
—	—	—	—	$\frac{29}{32}$	N. end, new cracks in courses 7 to 10 at 4″ from N.W. angle.
					W. face cracked from bottom up to course 8.
—	—	—	—	$\frac{30}{32}$	Pressure fell; then courses 11 to 14 burst out at S.E. angle, and the wall collapsed. (See photograph, fig. 7, p. 81.)

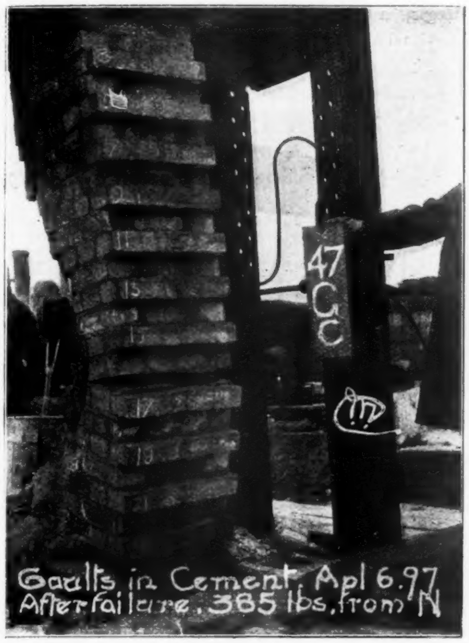


FIG. 17.

FIG. 18.

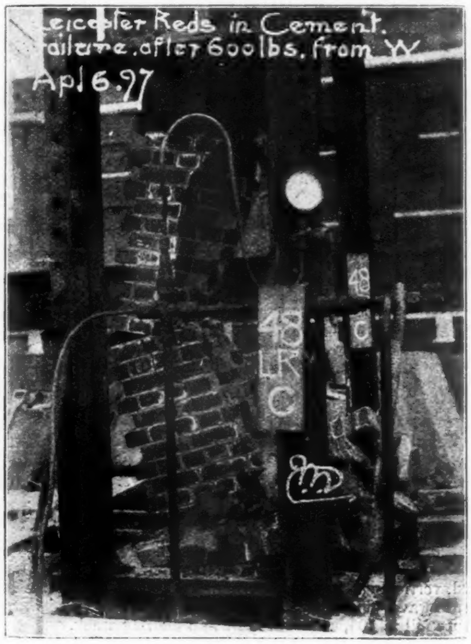


FIG. 19.

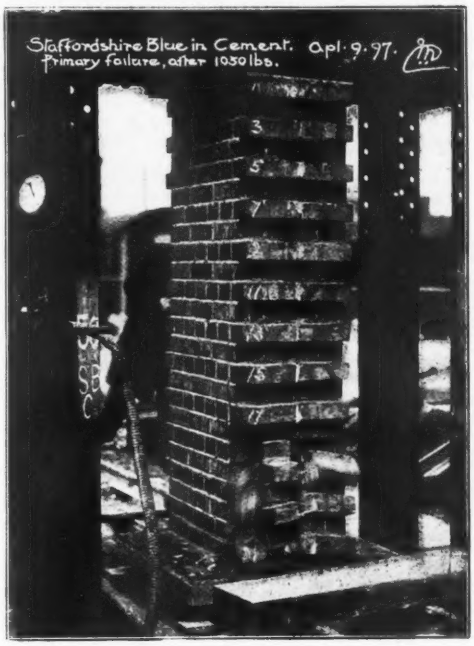


FIG. 20.

No. 40.—Blue Bricks from Rowley Regis, in Lime Mortar 1 to 2.

Wall 6′ $1\frac{3}{8}$″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 29th October; crushed 31st March. Age $21\frac{6}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
3.34½	13	3·33	·99	—	In bearing.
3.36	23	7·97	2·36	$\frac{2}{32}$	
3.36½	32	12·15	3·60	$\frac{3}{32}$	
3.37	40	15·86	4·70	$\frac{4}{32}$	
3.38¼	68	28·85	8·55	$\frac{6}{32}$	
3.39	90	39·06	11·57	$\frac{7}{32}$	
3.39½	103	45·09	13·36	$\frac{8}{32}$	
3.40	120	52·98	15·70	$\frac{9}{32}$	
3.40¼	128	56·69	16·80	$\frac{10}{32}$	
3.41	138	61·33	18·17	$\frac{11}{32}$	
--	150	66·90	19·82	—	Slight disintegration of joint faces generally, worst nearest bottom.
3.42	152	67·83	20·10	$\frac{12}{32}$	W. face, small piece split off course 1, next iron plate.
3.43	161	72·00	21·33	$\frac{13}{32}$	
3.44½	169	75·72	22·44	$\frac{14}{32}$	
3.47½	183	82·21	24·36	$\frac{15}{32}$	
3.49	190	85·46	25·32	$\frac{16}{32}$	
3.52	203	91·49	27·10	$\frac{17}{32}$	
3.55	218	98·45	29·17	$\frac{18}{32}$	
3.57¼	232	104·94	31·09	$\frac{19}{32}$	
3.58	245	110·98	32·88	$\frac{20}{32}$	E. face, hair cracks in vertical joints, courses 12 to 16.
					W. face, crack in brick at north end of bottom course.
4.0	255	115·62	34·26	$\frac{21}{32}$	S. end, crack in centre of course 22.
					W. face, crack in course 4, 6″ from N. end.
4.0¼	260	117·94	34·94	$\frac{22}{32}$	E. face, mortar dropping slightly off joints.
4.2	290	131·86	39·07	$\frac{23}{32}$	Slight internal sounds.
4.3	310	141·14	41·82	$\frac{25}{32}$	
4.3½	320	145·78	43·19	$\frac{26}{32}$	E. face, no bricks cracked yet.
4.4½	340	155·06	45·94	$\frac{27}{32}$	
4.5	348	158·77	47·04	$\frac{28}{32}$	
4.6½	370	168·98	50·07	$\frac{29}{32}$	Mortar falling badly.
					W. face, crack in course 1, 8″ from N. end.
4.7	375	171·30	50·75	$\frac{30}{32}$	
4.8	390	178·26	52·82	$\frac{31}{32}$	
4.9	405	185·22	54·88	1	
4.10¼	425	194·50	57·63	$1\frac{1}{32}$	
4.10¾	430	196·82	58·32	$1\frac{2}{32}$	Audible crack.
					W. face, crack in course 24, 4″ from N. end.
4.12	455	208·42	61·75	$1\frac{3}{32}$	N. end, hair crack in centre of course 18.
4.12½	480	220·02	65·19	$1\frac{4}{32}$	
4.13½	495	226·98	67·25	$1\frac{5}{32}$	Wall bent slightly convex towards W. for whole height.
					Audible crack.
4.14	500	229·30	67·94	$1\frac{6}{32}$	E. face, crack in course 12, 10½″ from S.E. angle.
4.15	515	236·26	70·00	$1\frac{7}{32}$	E. face, hair crack in centre of course 10.
4.16½	530	243·22	72·06	$1\frac{8}{32}$	E. face, crack at joint in course 13, 12½″ from S.
					S. end, crack in centre of course 13.
4.18	548	251·57	74·54	$1\frac{9}{32}$	E. face, joints in courses 6 to 9 cracked and slightly opening.
					S. end, continuous crack, courses 17 to 23.
4.20	570	261·78	77·56	$1\frac{10}{32}$	E. face, hair crack in course 14, 11″ from N.E. angle.
					All joint faces burst off.
					S. end, cracks in courses 2 and 4, 6″ from W. face.
4.21	605	278·02	82·38	$1\frac{11}{32}$	W. face, cracks in courses 8 and 10, 4″ from S. end.
4.22	615	282·66	83·75	$1\frac{12}{32}$	N. end, hair crack in centre of course 14.
4.23	625	287·30	85·12	$1\frac{13}{32}$	
4.25	640	294·26	87·19	$1\frac{14}{32}$	E. face, hair crack in course 6, 6″ from S.E. angle.
					W. face, cracks in courses 14 to 24, near N. end.
					W. face, cracks in courses 1 to 10, near S. end.
					S. end, cracks in courses 6 and 7.
4.26½	645	296·58	87·87	—	N. end, hair crack in course 21, 3″ from N.W. angle.
4.27	638	293·33	86·91	$1\frac{15}{32}$	Pressure fell 7 lbs., but the compression continued.
4.31	675	310·50	92·00	$1\frac{16}{32}$	N. end, vertical crack at centre extended up through course 12.
4.33	690	317·46	94·06	—	Pressure wavered slightly.
4.38	720	331·38	98·19	$1\frac{17}{32}$	Pressure fell to 705, when there was an audible crack.
4.39	720	331·38	98·19	$1\frac{18}{32}$	Pressure rose again to 720.
					S. end, cracks in courses 14 to 24 and 2 to 10.
4.42	750	345·30	102·31	$1\frac{19}{32}$	N. end, stretcher at centre of course 16 sound, but cracks above and below it at centre.

[No. 40 continued on p. 90.

FIG. 21.

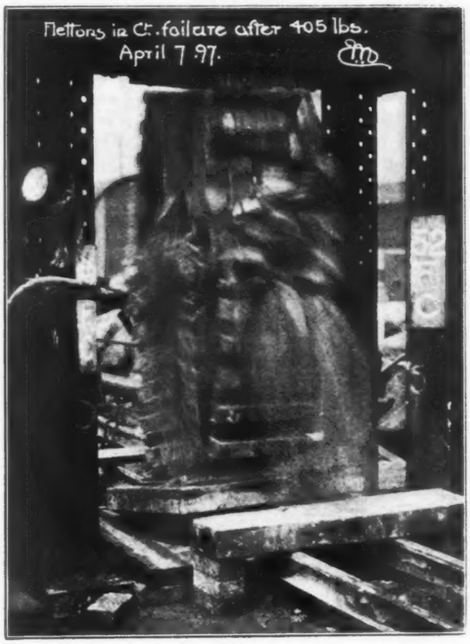


FIG. 22.

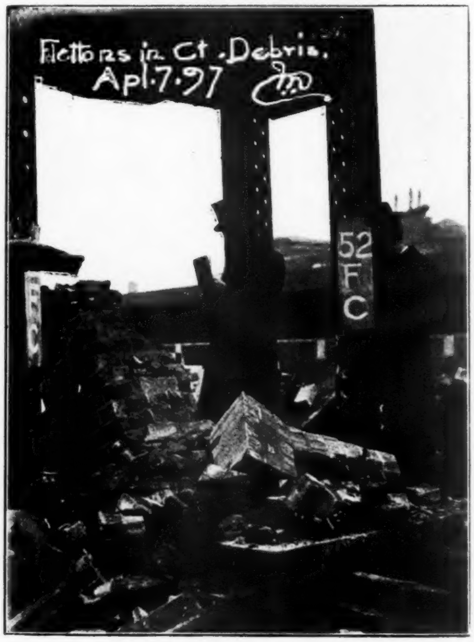


FIG. 23.

FIG. 24.

No. 40 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
4.45	800	368·50	109·18	$1\frac{20}{32}$	N. end split in course 4, 5″ from N.E. angle.
4.47	820	377·78	111·93	$1\frac{21}{32}$	Visible jump of wall, accompanied by sharp audible crack. Pressure then fell to 800.
					N. end, the stretcher at centre of course 16 cracked. (See note at 750 lbs.)
					Pressure fell to 800, then rose again.
4.49	820	377·78	111·93	—	N. end, a continuous crack from centre of course 11 to bottom of wall.
4.50	830	382·42	113·31	$1\frac{22}{32}$	E. face, irregular cracks from top to bottom at S. end.
4.53	—	—	—	—	Pressure fell to 820, and then to below 800, the cracking of wall meantime increasing. (See photograph, fig. 8, p. 81.)
4.56	800	368·50	109·18	$1\frac{23}{32}$	Wall crippled, and pressure somewhat rapidly applied.
5.0	860	396·34	117·43	—	Wall in worst condition at courses 18 to 20, near S.E. angle;
5.0¼	865	398·66	118·12	—	it then failed, the southern end falling out first. (See photograph, fig. 9, p. 83.)

No. 41.—Blue Bricks from Rowley Regis, in Lime Mortar 1 to 2.

Wall 6′ 1¾″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 29th October; crushed 31st March. Age 21$\frac{6}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
10.32¼	15	4·26	1·26	—	In bearing.
10.35	25	8·90	2·63	$\frac{1}{32}$	
10.35½	39	15·40	4·56	$\frac{2}{32}$	
10.36½	58	24·21	7·17	$\frac{3}{32}$	
10.37	82	35·35	10·47	$\frac{4}{32}$	
10.38	105	46·02	13·63	$\frac{5}{32}$	
10.38¼	119	52·52	15·56	$\frac{6}{32}$	
10.38½	130	57·62	17·07	$\frac{7}{32}$	
10.39	139	61·79	18·31	$\frac{8}{32}$	
10.39½	150	66·90	19·82	$\frac{9}{32}$	
10.40½	168	75·25	22·30	$\frac{11}{32}$	
10.41	178	79·89	23·67	$\frac{12}{32}$	
10.41½	187	84·07	24·91	$\frac{13}{32}$	
10.42	198	89·17	26·41	$\frac{14}{32}$	
10.42½	205	92·42	27·38	$\frac{15}{32}$	
10.43	212	95·67	28·35	$\frac{16}{32}$	Mortar squeezing out on E. and W. faces.
10.43½	225	101·70	30·13	$\frac{17}{32}$	
10.44	240	108·66	32·19	$\frac{18}{32}$	
10.44½	250	113·30	33·57	$\frac{19}{32}$	
10.45½	260	117·94	34·94	$\frac{21}{32}$	
10.47	275	124·90	37·01	$\frac{22}{32}$	
10.47½	285	129·54	38·38	$\frac{23}{32}$	
10.48½	300	136·50	40·44	$\frac{24}{32}$	
10.49½	310	141·14	41·82	$\frac{25}{32}$	
10.50	320	145·78	43·19	$\frac{26}{32}$	Mortar falling freely.
10.51	330	150·42	44·57	$\frac{27}{32}$	
10.51½	340	155·06	45·94	$\frac{28}{32}$	
10.53	355	162·02	48·01	$\frac{29}{32}$	
10.54	370	168·98	50·07	$\frac{30}{32}$	
10.55½	380	173·62	51·44	$\frac{31}{32}$	
10.56½	395	180·58	53·51	$\frac{32}{32}$	
10.58	405	185·22	54·88	$\frac{33}{32}$	
10.58½	410	187·54	55·57	—	Sound of internal cracking.
10.59	415	189·86	56·25	$\frac{34}{32}$	
11.0½	425	194·50	57·63	$\frac{35}{32}$	
11.2	435	199·14	59·00	$\frac{36}{32}$	S. end, two cracks in centre brick of course 12.
					W. face, crack in joints of courses 4 and 6, S. end.
11.4	450	206·10	61·06	$\frac{37}{32}$	N. end, crack near centre of course 10.
					N. end, crack in course 1, near W. face.
11.5	460	210·74	62·44	$\frac{38}{32}$	
11.9	470	215·38	63·82	$\frac{39}{32}$	E. face, crack in course 12, near N. end, and detached cracks in courses 4, 12, 14, 20, and 24, at S. end.
11.12	480	220·02	65·19	$\frac{40}{32}$	
11.15	490	224·66	66·57	—	E. face, crack in course 10, at N. end.
11.18	500	229·30	67·94	$\frac{41}{32}$	Internal cracking audible.
					W. face, crack in course 8, 6″ from N. end.
					W. face, crack in course 22, at N. joint.
11.22	535	245·54	72·75	$\frac{42}{32}$	

[No. 41 continued on p. 91

No. 41 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
11.24	560	257·17	76·19	$\frac{43}{32}$	
11.26	570	261·78	77·56	$\frac{45}{32}$	
11.27½	580	266·42	78·94	$\frac{46}{32}$	
11.28	585	268·74	79·63	—	All joint faces on E. and W. faces gone.
11.29	595	273·38	81·00	$\frac{47}{32}$	
11.33	605	278·02	82·38	$\frac{48}{32}$	
11.35	620	284·98	84·44	—	N. end, crack in course 8, 6″ from W. face.
					S. end, several fine cracks in course 4, near E. face.
11.37½	630	289·62	85·81	$\frac{49}{32}$	E. face, crack near centre of course 14.
					N. end, crack near centre of course 18.
11.40	640	294·26	87·19	$\frac{50}{32}$	
11.42	680	312·82	92·69	$\frac{51}{32}$	N. end, crack near centre of course 12.
11.43	700	322·10	95·44	$\frac{52}{32}$	Several audible crackings.
11.45	740	340·66	100·93	$\frac{53}{32}$	A loud crack.
11.46	760	349·94	103·69	$\frac{55}{32}$	N. end, crack in centre of course 6.
					W. face, irregular hair cracks from course 14 to 24, near S. end.
11.47	780	359·22	106·43	$\frac{57}{32}$	N. end, opening about course 12.
					S. end, cracks in courses 5, 6, and 7, near W. face, that in course 5 open $\frac{1}{32}$.
11.47½	790	363·86	107·81	$\frac{59}{32}$	
11.48	800	368 50	109·18	$\frac{60}{32}$	S. end, cracked centre, courses 3 to 10.
11.48½	805	370·82	109·88	$\frac{61}{32}$	Wall bulging toward W.
—	—	—	—	$\frac{65}{32}$	
11.50	810	373·14	110·56	—	Wall split right down N. end at centre. Bent in centre 3″ towards W., and then failed. (See photographs, figs. 10, 11, and 12, p. 83.)
11.52½	—	—	—	—	
					The bricks in the interior were more shattered than those in the exterior.

No. 42.—Fletton Bricks, in Lime Mortar 1 to 2.

Wall 6′ 1½″ high ; 27″ × 18″ ; sectional area 3·375 sq. ft.
Built 29th October ; crushed 2nd April. Age 22½ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
1.49	15	4·26	1·26	—	In bearing.
1.50	18	5·65	1·67	$\frac{2}{32}$	
1.51	23	7·97	2·36	$\frac{3}{32}$	
1.51½	30	11·22	3·32	$\frac{4}{32}$	
1.52½	45	18·18	5·39	$\frac{5}{32}$	
1.53	65	27·46	8·13	$\frac{6}{32}$	
1.54	105	46·02	13·63	$\frac{7}{32}$	
1.54½	117	51·59	15·29	$\frac{8}{32}$	
1.57	130	57·62	17·07	$\frac{9}{32}$	
2.0	141	62·72	18·58	$\frac{10}{32}$	
2.5	153	68·29	20·23	—	E. face, split $\frac{1}{16}$″ wide in course 24, ¾″ from S. end.
2.6	155	69·22	20·51	$\frac{11}{32}$	
2.10	167	74·79	22·16	$\frac{12}{32}$	
2.14	182	81·75	24·22	$\frac{13}{32}$	
2.16	190	85·46	25·32	$\frac{14}{32}$	
2.18½	197	88·71	26·28	—	S. end, cracks in centres of courses 4, 20, and 22, and in course 13, 4″ from W. face.
2.19	200	90·10	26·69	—	E. face, cracks in courses 3 and 4, 2¼″ from S. end.
2.21	205	92·42	27·38	—	E. face, mortar slightly disintegrated at beds of courses 12 and 14, and thence down to course 20.
2.22	208	93·81	27·79	$\frac{15}{32}$	
2.23	210	94·74	28·07	—	S. end, crack in courses 13 to 16 at W. joint, and in course 15 at E. joint ; also in centre of courses 18 to 24.
2.25	215	97·06	28·76	$\frac{16}{32}$	E. face, crack in course 16, 1½″ from S. end.
					E. face, crack in courses 16 and 17, 4¼″ from S. end.
2.25½	220	99·38	29·44	—	N. end, crack in centre of course 4.
					W. face, crack in course 10 at N. end, and in centre of courses 8 to 21.
2.27½	230	104·02	30·82	$\frac{17}{32}$	E. face, cracks opening, the worst barely $\frac{1}{16}$″.
2.30	—	—	—	—	The wall bent, S. face fell out, and wall failed.
					The bricks were broken into about three pieces each throughout the bulk of the work. Only the bottom course remained in place after failure.

No. 43.—Fletton Bricks, in Lime Mortar 1 to 2.

Wall 6′ 1¼″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 29th October; crushed 2nd April. Age 22½ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
3.11	18	5·65	1·67	—	In bearing.
3.13	26	9·36	2·77	$\frac{1}{32}$	
3.14	35	13·54	4·01	$\frac{2}{32}$	
3.17	54	22·36	6·62	$\frac{3}{32}$	
3.19¼	73	31·17	9·23	$\frac{4}{32}$	
3.20	80	34·42	10·20	—	Audible crack.
3.21	100	43·70	12·95	$\frac{5}{32}$	
3.22	115	50·66	15·01	$\frac{6}{32}$	
3.24	150	66·90	19·82	$\frac{8}{32}$	
3.24½	165	73·86	21·88	—	S. end, crack in centre of courses 2 to 4.
—	168	75·25	22·30	$\frac{9}{32}$	
3.25½	180	80·82	23·95	$\frac{10}{32}$	E. face, crack in courses 14 to 16, 4½″ from S. end.
					W. face, cracks in courses 10 and 14, near S. end.
3.26	190	85·46	25·32	$\frac{11}{32}$	E. face, crack in course 17, 9″ from S. end.
					E. face, continuous diagonal crack in courses 12 to 14, at S. end.
3.26½	198	89·17	26·42	$\frac{12}{32}$	
3.27	210	94·74	28·07	$\frac{13}{32}$	W. face, crack in course 20, at S. end.
3.28	215	97·06	28·76	$\frac{14}{32}$	
3.28¼	220	99·38	29·44	$\frac{15}{32}$	S. end, crack right down centre.
—	—	—	—	$\frac{16}{32}$	
3.29	225	101·70	30·13	$\frac{17}{32}$	N. end, crack at centre of course 18.
—	—	—	—	$\frac{18}{32}$	E. face, cracks near centre of courses 12 to 16.
—	—	—	—	$\frac{19}{32}$	
3.30	228	103·09	30·54	$\frac{20}{32}$	W. face cracked all over.
					The S.E. corner crumbled, and then collapse followed.

No. 44.—Stock Bricks from Sittingbourne, in Portland Cement Mortar 1 to 4.

Wall 6′ 0½″ high; 28″ × 18½″; sectional area 3·597 sq. ft.
Built 3rd November; crushed 2nd April. Age 21¾ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
4.7½	14	3·79	1·05	—	In bearing.
4.7¾	15	4·26	1·18	$\frac{2}{32}$	These readings of the compression gauge cannot represent actual compression of wall, but must be occasioned by some abnormal fixing of gauge.
—	—	—	—	$\frac{3}{32}$	
4.9	19	6·12	1·70	$\frac{5}{32}$	
4.10	24	8·44	2·34	$\frac{6}{32}$	
4.11	46	18·64	5·18	$\frac{7}{32}$	
4.12	70	29·78	8·28	$\frac{8}{32}$	
4.12¼	90	39·06	10·86	$\frac{9}{32}$	
4.12½	103	45·09	12·53	$\frac{10}{32}$	
4.13¼	124	54·84	15·25	$\frac{11}{32}$	
4.14	148	65·97	18·34	$\frac{12}{32}$	
4.15	174	78·04	21·69	$\frac{13}{32}$	
4.18	195	87·78	24·40	$\frac{14}{32}$	
4.22½	235	106·34	29·56	$\frac{15}{32}$	E. face, courses 21 to 24 cracked at N. end; the bottom course (24) spalled at both ends.
4.24	265	120·26	33·43	$\frac{16}{32}$	N. end, bottom course crushing on plate; small spalls.
4.26	290	131·86	36·66	$\frac{17}{32}$	
4.27	300	136·50	37·95	$\frac{18}{32}$	E. face, course 1 split, in line with N. end of stretcher immediately below it, at N. end.
					N. end, courses 10 to 24 cracked at each of three vertical joint lines, and part fell out from course 11 to 24.
4.29	310	141·14	39·24	$\frac{19}{32}$	Failed by shearing downward from S. to N., the fracture clean through brick and cement. (See photograph, fig. 13, p. 85.)

No. 45.—Stock Bricks from Sittingbourne, in Portland Cement Mortar 1 to 4.

Wall 6′ 0½″ high; 28″ × 18¾″; sectional area 3·646 sq. ft.
Built 3rd November; crushed 6th April. Age 22 weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
10.46	13	3·33	·91	—	In bearing.
10.48	15	4·26	1·17	$\frac{2}{32}$	
10.50	20	6·58	1·80	$\frac{3}{32}$	
10.51	29	10·76	2·95	$\frac{4}{32}$	
10.53	45	18·18	4·99	$\frac{5}{32}$	
10.55	70	29·78	8·17	$\frac{6}{32}$	
10.58	114	50·20	13·77	$\frac{7}{32}$	
11.1	165	73·86	20·26	$\frac{8}{32}$	
11.4	205	92·42	25·35	$\frac{9}{32}$	S. end, crack near centre of course 7.
					E. face, toothing at S. end of course 21 cracked in line with ends of stretchers.
11.6	230	104·02	28·53	—	E. face, crack in courses 17 and 18, 3″ from N. end; also toothing at N. end of course 17 cracked in line with end of stretchers.
11.7	250	113·30	31·07	$\frac{10}{32}$	E. face, course 22 spalled 2″ from S. end.
11.9	275	124·90	34·26	—	N. end, crack in course 11, 3″ from W. face.
11.9½	290	131·86	36·16	$\frac{11}{32}$	Considerable crepitation heard.
11.10	295	134·18	36·80	—	S. end, crack at centre of courses 18 to 20.
11.11	305	138·82	38·07	—	S. end, crack continued upward to course 16.
					E. face, crack 2″ from S. end, continuing from course 16 to 24.
11.11½	310	141·14	38·71	$\frac{12}{32}$	S. end, crack in course 22, 4″ from E. face.
					N. end, crack in course 15, 3″ from E. face.
					Sharp crack heard.
11.12½	315	143·46	39·34	$\frac{13}{32}$	W. face cracked near centre and extending.
					The N.E. corner fell off from top downward; then the S. end followed, and the whole failed. (See photographs, figs. 14 and 15.)

No. 46.—Gault Bricks from Burham, Kent, in Portland Cement Mortar 1 to 4.

Wall 6′ 0½″ high; 27½″ × 18⅛″; sectional area 3·461 sq. ft.
Built 3rd November; crushed 6th April. Age 22 weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
11.51	18	5·65	1·63	—	In bearing.
11.51½	19	6·12	1·77	$\frac{1}{32}$	
11.53	28	10·29	2·97	$\frac{2}{32}$	
11.56	60	25·14	7·26	$\frac{3}{32}$	
11.57½	98	42·77	12·35	$\frac{4}{32}$	
11.59	150	66·90	19·33	$\frac{5}{32}$	
12.1	187	84·07	24·29	$\frac{6}{32}$	
12.6	225	101·70	29·38	—	S. end, crack in centre of course 22, and through joint of same course.
12.6½	230	104·02	30·05	—	E. face, hair crack in course 1 at toothing next N. end.
					E. face, crack in course 7 at S. end.
12.8½	245	110·98	32·06	$\frac{7}{32}$	
12.14½	285	129·54	37·42	$\frac{8}{32}$	E. face, crack in course 21 at N. end.
12.20	315	143·46	41·45	—	N. end, crack in course 21, 8½″ from E. face, and opening slightly.
					E. face, crack in course 22, 2″ from N. end.
12.21½	320	145·78	42·12	$\frac{9}{32}$	
12.22	325	148·10	42·79	—	E. face, cracks in courses 20 to 23, 2″ from N. end.
12.23½	335	152·74	44·13	—	N. end, cracks in courses 21 to 23, near E. face.
					N.E. angle, small flake off bottom course, and bottom four courses close to angle shattered and cracks opening.

[No. 46 continued on p. 94.

No. 46 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
12.25¼	340	155·06	44·80	—	Audible cracking.
					S. end, cracks in courses 19, 20, and 23, near centre.
12.26	345	157·38	45·47	$\frac{10}{32}$	N.E. angle, top two courses shattered, arris of brick split.
					E. face, hair crack in centre of course 16.
					N. end, course 20 to bottom, crack about 3″ from E. face opened $\frac{1}{32}$″.
12.26½	365	166·66	48·15	—	N. end, cracks at centre of courses 18 to 21.
					S. end, crack in centre extended up to course 16.
12.27½	370	168·98	48·82	$\frac{11}{32}$	N. end, centre crack extended from course 14 to 21.
12.29	380	173·62	50·16	$\frac{12}{32}$	N. end, centre crack extending up and down.
					S. end, crack in centre extended to course 12.
					Audible breaking of bricks.
12.35	390	178·26	51·50	$\frac{13}{32}$	N. end, hair crack at centre of course 2.
—	—	—	—	$\frac{14}{32}$	
—	—	—	—	$\frac{15}{32}$	
12.44	—	—	—	—	Wall split through from N. to S.; then bulged to W., and fell. (See photograph, fig. 16.)
					Cement was set but not quite dry.

No. 47.—Gault Bricks from Burham, Kent, in Portland Cement Mortar 1 to 4.

Wall 6′ 0⅜″ high; 27½″ × 18″; sectional area 3·437 sq. ft.
Built 3rd November; crushed 6th April. Age 22 weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
2.1	14	3·79	1·10	—	In bearing.
2.1¼	15	4·26	1·24	—	
2.3	17	5·19	1·51	$\frac{1}{32}$	
2.5	21	7·04	2·05	$\frac{2}{32}$	
2.9	39	15·40	4·05	$\frac{3}{32}$	
2.11	60	25·14	7·31	$\frac{4}{32}$	
2.15	135	59·94	17·44	$\frac{5}{32}$	
2.16	155	69·22	20·14	—	E. face, hair crack in course 1, ½″ from N. end.
2.19	200	90·10	26·21	$\frac{6}{32}$	
2.20	220	99·38	28·91	—	Slight but repeated crepitations.
2.24	274	124·44	36·21	$\frac{7}{32}$	
2.25½	295	134·18	39·04	—	Slight crepitations.
2.27	310	141·14	41·06	—	Slight crepitations.
2.29	340	155·06	45·11	—	E. face, hair crack in course 24, 2″ from S. end.
					W. face, crack in courses 1 to 6, 6″ from S. end.
					W. face, crack in courses 13 to 16, near S. end.
					W. face, crack in courses 18 to 23, near N. end.
2.30	355	162·02	47·14	—	Audible cracks at intervals.
					N. end, hair crack at centre of course 2.
2.31	360	164·34	47·81	$\frac{8}{32}$	S. end, crack at centre of courses 14 to 24.
2.32	375	171·30	49·84	—	N. end, crack in centre of courses 14 to 18, and continuing downwards to course 20.
					W. face, crack in course 5, third header from N. end.
2.33½	385	175·94	51·19	—	E. face, crack in courses 13 to 20, which, without increase of pressure, extended until it reached from course 5 to base of wall.
					W. face, crack near S. end extended upward to course 11.
					Wall bulged towards the N., and broke at bed of course 16.
					N. end, above and below fracture, almost unbroken; the whole of S. end quite shattered and split off. (See photograph, fig. 17.)
					Cement well set.

No. 48.—Red Bricks from Ellistown, near Leicester, in Portland Cement Mortar 1 to 4.

Wall 6′ $0\frac{5}{8}$″ high ; $27\frac{1}{4}$″ × 18″; sectional area 3·406 sq. ft.
Built 10th November; crushed 6th April. Age 21 weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
$3.11\frac{1}{2}$	15	4·26	1·25	—	In bearing.
3.12	17	5·19	1·52	$\frac{1}{32}$	
3.13	21	7·04	2·06	$\frac{2}{32}$	
3.14	27	9·83	2·88	$\frac{3}{32}$	
$3.16\frac{1}{2}$	47	19·11	5·31	$\frac{4}{32}$	
$3.18\frac{1}{2}$	88	38·13	11·19	$\frac{5}{32}$	
3.20	190	85·46	25·09	$\frac{6}{32}$	
3.24	270	122·58	35·99	$\frac{7}{32}$	
$3.25\frac{1}{2}$	335	152·74	44·84	—	E. face, course 1 flaked slightly at top near N. end.
$3.28\frac{1}{2}$	420	192·18	56·42	$\frac{8}{32}$	
$3.30\frac{1}{2}$	460	210·74	61·87	—	E. face, course 24 split at 1″ from S. end.
$3.34\frac{1}{2}$	505	231·62	68·00	$\frac{9}{32}$	S. end, crack in courses 19 to 21, near W. face.
3.36	515	236·26	69·37	—	N. end, hair crack at centre, courses 1 to 3.
					S. end, crack at centre, courses 1 to 6.
					S. end, crack at centre, course 18.
$3.37\frac{1}{2}$	520	238·58	70·05	—	S. end, crack at centre, courses 16 and 20.
					S. end, crack at centre, course 14.
					W. face, crack in courses 1 to 3, near S. end.
3.42	535	245·54	72·09	—	E. face, hair crack in course 2, 2″ from N. end; this cracked with a sharp sound.
					S. end, crack in bottom brick, next E. face.
3.47	595	273·38	80·26	—	S. end, crack in centre of course 12.
3.48	600	275·70	80·94	—	S. end, crack in centre of course 8.
					The wall suddenly bent towards N., and collapsed.
					Not one brick of S. end left unbroken.
					The whole of the toothings at N. end remained intact. (See photographs, figs. 18 and 19.)

No. 49.—Red Bricks from Ellistown, near Leicester, in Portland Cement 1 to 4.

Wall 6′ $0\frac{1}{2}$″ high ; $27\frac{1}{4}$″ × $18\frac{1}{8}$″ ; sectional area 3·43 sq. ft.
Built 10th November; crushed 7th April. Age $21\frac{1}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
$10.36\frac{1}{2}$	15	4·26	1·24	—	In bearing.
$10.37\frac{1}{2}$	18	5·65	1·65	$\frac{1}{32}$	
$10.38\frac{1}{2}$	22	7·50	2·19	$\frac{2}{32}$	
10.41	38	15·93	4·64	$\frac{3}{32}$	
$10.43\frac{1}{2}$	80	34·42	10·03	$\frac{4}{32}$	
$10.45\frac{1}{2}$	135	59·94	17·47	$\frac{5}{32}$	
$10.48\frac{1}{2}$	220	99·38	28·10	$\frac{6}{32}$	
$10.54\frac{1}{2}$	365	166·66	48·59	$\frac{7}{32}$	E. face, course 24 shattered at 1″ from S. end.
10.56	400	182·90	53·32	—	W. face, course 24 shattered at S.W. corner.
$11.4\frac{1}{2}$	470	215·38	62·79	—	W. face, crack in course 3, 9″ from S. end.
11.7	490	224·66	65·50	$\frac{8}{32}$	W. face, crack in course 3 extended to course 5.
11.9	500	229·30	66·85	—	W. face, crack in course 24, S.W. corner, extended to course 23.
11.16	540	247·86	72·26	—	E. face, crack in courses 23 and 24, 2″ from S. end.
11.17	550	252·50	73·61	—	E. face, hair crack from top to course 5, 9″ from S. end.
					W. face, crack extended from course 3 to top.
					S. end, crack in centre of course 2.
11.19	570	261·78	76·32	—	S. end, crack in centre of courses 23 and 24.
					S. end, crack in course 2 extended to course 4.
					N. end, hair crack in centre of courses 1 and 2.
					E. face, crack in courses 22, 23, and 24, at S. corner.

[No. 49 continued on p. 96.

No. 49 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
11.26½	595	273·38	79·70	—	E. face, crack in course 1, at N. end.
11.32	620	284·98	83·09	$\frac{9}{32}$	E. face, crack from course 1 to 7, 9″ from S. end.
					W. face, crack from course 1 to 7, 9″ from S. end.
					S. end, crack in centre of courses 2 to 5.
					W. face, crack in courses 19 to 22, at S. end.
11.39	640	294·26	85·78	—	E. face, sudden split in courses 14 to 24, 2″ from S. end.
					The pressure fell, but the wall generally looked sound.
					The crack on E. face at 9″ from S. end continued down from course 7 to 13, and opened slightly.
11.48	—	—	—	—	S end fell off in pieces, wall bent at bed of course 13, the N. end remaining intact. The head of ram then heeled over to N., and the upper part of wall fell in one piece to N., but did not separate on striking the ground.
					The cement was set and very slightly damp.

No. 50.—Blue Bricks from Rowley Regis, in Portland Cement Mortar 1 to 4.

Wall 6′ 0½″ high; 27¼″ × 18″; sectional area 3·406 sq. ft.

Built 10th November; crushed 9th April. Age 21$\frac{3}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
1.44	19	6·12	1·79	—	In bearing.
1.45	25	8·90	2·61	$\frac{1}{32}$	
1.45½	32	12·15	3·57	$\frac{2}{32}$	
1.46½	54	22·36	6·56	$\frac{3}{32}$	
1.48	95	41·38	12·15	$\frac{4}{32}$	
1.49	230	104·02	30·54	$\frac{5}{32}$	
—	400	182·90	53·70	—	At about this pressure slight internal crepitations were audible on applying the ear to the wall.
1.50½	425	194·50	57·10	$\frac{6}{32}$	
—	560	257·14	75·49	—	No sign of injury on N. end or E. face.
2.4	600	275·70	80·94	$\frac{7}{32}$	
2.10	690	317·46	93·21	—	S.E. angle, brick in bottom course spalling.
2.11½	720	331·38	97·29	$\frac{8}{32}$	W. face, crack in courses 1 to 4, 6″ from S. end.
2.14	790	363·86	106·83	—	E. face, hair crack in course 22, 2½″ from S. end.
					E. face, hair crack in courses 1 to 3, 9″ from N. end.
2.15	820	377·78	110·91	—	N. end, hair crack at centre of courses 2 to 5.
					E. face, course 23 spalled at S. end.
2.16½	850	391·70	115·00	$\frac{9}{32}$	E. face, hair crack in courses 20 to 23, 2¼″ from S. end.
2.17½	880	405·62	119·09	—	W. face, crack noted at 720 extended to course 7, 9″ from S. end.
2.18½	940	433·46	127·26	$\frac{10}{32}$	E. face, hair crack in course 2, 6″ from S. end.
					N. end, crack previously noted in course 4 opening.
					S. end, crack in centre of courses 14 to 24.
2.20	1000	461·30	135·44	—	S. end, crack in centre of courses 1 to 8.
					N. end, crack in courses 5 to 9, 6″ from E. face.
—	1020	470·58	138·16	$\frac{11}{32}$	
2.21	1030	475·22	139·52	$\frac{12}{32}$	S. end, crack in courses 11 to 13, near W. face.
2.22	—	—	—	—	Failed very suddenly by shearing. The bottom portion, comprising about ten courses, was thrown off ram and turned over, after which a block of the seven bottom courses remained intact, save 4½″ of the S. end.
					Cement set and nearly dry, not much adhesion to bricks.
					Bricks not shattered, but in pieces of ¼ brick and upwards, many unbroken bricks, and blocks of work remaining. (See photographs, figs. 20 and 21.)

No. 51.—Blue Bricks from Rowley Regis, in Portland Cement Mortar 1 to 4.

Wall 6′ $0\frac{1}{8}$″ high; $27\frac{1}{4}$″ × 18″; sectional area 3·406 sq. ft.
Built 10th November; crushed 9th April. Age $21\frac{3}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
10.35	17	5·19	1·52	—	In bearing.
$10.35\frac{1}{4}$	18	5·65	1·66	$\frac{2}{32}$	
10.37	41	16·32	4·79	$\frac{4}{32}$	Slight crack heard.
10.39	380	173·62	50·97	$\frac{6}{32}$	Slight crack heard.
—	440	201·46	59·15	—	N. end, small spall flew off course 2, 1″ from E. face.
$10.42\frac{1}{2}$	470	215·38	63·23	$\frac{8}{32}$	
10.48	505	231·62	68·00	—	S. end, diagonal crack across projecting toothing in course 23.
10.55	540	247·86	72·77	—	N. end, crack in course 2, $\frac{3}{8}$″ from E. face, open $\frac{1}{64}$″.
11.10	635	291·94	85·71	$\frac{9}{32}$	Audible cracks.
					E. face, hair crack in courses 2 to 4, 9″ from S. end.
11.15	640	294·26	86·39	—	W. face, crack, courses 1 to 3, 6″ from S. end.
					W. face, crack, courses 1 to 3, extended to course 4.
11.18	650	298·90	87 76	—	Sharp crack heard, as of brick snapping.
11.19	655	301·22	88·44	—	W. face, crack noted at 640 extended to course 5.
$11.21\frac{1}{2}$	690	317·46	93·21	—	Bottom brick at S.W. corner spalling.
11.25	740	340·66	100·02	$\frac{10}{32}$	E. face, crack noted at 635 extended courses 1 to 7.
—	750	345·30	101·38	—	E. face, crack noted at 635 opening very slightly.
11.28	770	354·58	104·10	—	S. end, crack in centre of courses 2 to 6.
11.32	830	382·42	112·28	—	S. end, crack in centre of courses 2 to 6 extended to course 8.
					N.E. angle of course 2 spalled off.
11.33	835	384·74	112·96	$\frac{11}{32}$	E. face, hair crack in course 2, 3″ from N. end.
					Pressure gauge fell to 775, the leakage of ram cylinder temporarily overcoming the hand pumping.
					N. end, hair crack in course 3, $2\frac{1}{4}$″ from E. face.
					N. end, hair crack in course 4, $4\frac{1}{2}$″ from E. face (at joint).
					N. end, hair crack in course 5, $2\frac{1}{2}$″ from E. face.
$11.46\frac{1}{2}$	850	391·70	115·00	—	N. end, hair crack in course 6, 4″ from E. face.
$11.47\frac{1}{2}$	930	428·82	125·90	$\frac{12}{32}$	E. face, crack in course 5, 9″ from N. end.
					W. face, crack in course 7.
$11.48\frac{1}{2}$	970	447·38	131·35	—	Wall failed by shearing from N. end at top to S. end at bottom. The bottom block jumped clean off ram, and a piece comprising greater part of wall from course 12 to 24 remained unbroken on the ground.
					Cement was set and nearly dry.

No. 52.—Fletton Bricks, in Portland Cement Mortar 1 to 4.

Wall 6′ $0\frac{5}{8}$″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 13th November; crushed 7th April. Age $20\frac{5}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
$1.17\frac{1}{2}$	14	3·79	1·12	—	In bearing.
—	16	4·72	1·40	$\frac{1}{32}$	
1.19	20	6·58	1·95	$\frac{2}{32}$	
—	31	11·68	3·46	$\frac{3}{32}$	
1.21	52	21·43	6·35	$\frac{4}{32}$	
1.23	105	46·02	13·63	$\frac{5}{32}$	
1.25	158	70·61	20·92	$\frac{6}{32}$	
1.26	250	113·30	33·57	$\frac{7}{32}$	E. face, hair crack in course 24, $1\frac{1}{2}$″ from S. end.
					E. face, hair crack in course 23, $\frac{1}{2}$″ from S. end.
					E. face, hair crack in course 1, $\frac{1}{2}$″ from N. end.
1.36	310	141 14	41·82	—	E. face, hair crack in course 10, $2\frac{1}{4}$″ from S. end.
—	320	145·78	43·19	$\frac{8}{32}$	S. end, sudden crack in centre of courses 1 to 7.
					W. face, crack in course 24 in brick at S. end.
—	330	150·42	44·57	—	N. end, hair crack in course 1, 6″ from E. face.

[No. 52 continued on p. 98.

No. 52 continued.]

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
1.39	335	152·74	45·26	$\frac{9}{32}$	E. face, hair crack in course 2, ½″ from S. end.
					S. end, crack in course 9, 4″ from E. face.
—	350	159·70	47·32	—	W. face, crack in course 2 at S. joint.
1.48	380	173·62	51·44	$\frac{10}{32}$	S. end, crack in centre of courses 19 to 21.
—	385	175·94	52·13	—	E. face, hair crack in course 2, 5″ from S. end.
					E. face, hair crack in course 3, 9″ from S. end.
					E. face, hair crack in course 4, 3″ from S. end.
					E. face, hair crack in course 6, 11″ from S. end.
					E. face, hair crack in courses 2 to 11, 2″ from S. end.
					N. end, courses 3 to 10 split at centre and opening a little.
—	395	180·58	53·50	$\frac{11}{32}$	E. face, a triangle, having as base the S.E. angle courses 1 to 11, and apex in course 6, and 12″ from S. end, full of cracks, showing general shattering of that part.
					S. end, crack in centre of course 10.
					W. face, crack in courses 10 to 22, 6″ from S. end.
					W. face, crack in courses 1 to 6, 9″ from N. end.
1.52	400	182·90	54·19	—	
1.53½	405	185·22	54·88	$\frac{12}{32}$	E. face, surface of header in course 8, 5″ from S. end, fell off.
					Wall failed suddenly, bending to N. at bed of course 11.
					N. end unbroken (save by cracks above noted) until moment of fall; S. end entirely shattered. (See photographs, figs. 22 and 23.)

No. 53.—Fletton Bricks in Portland Cement Mortar 1 to 4.

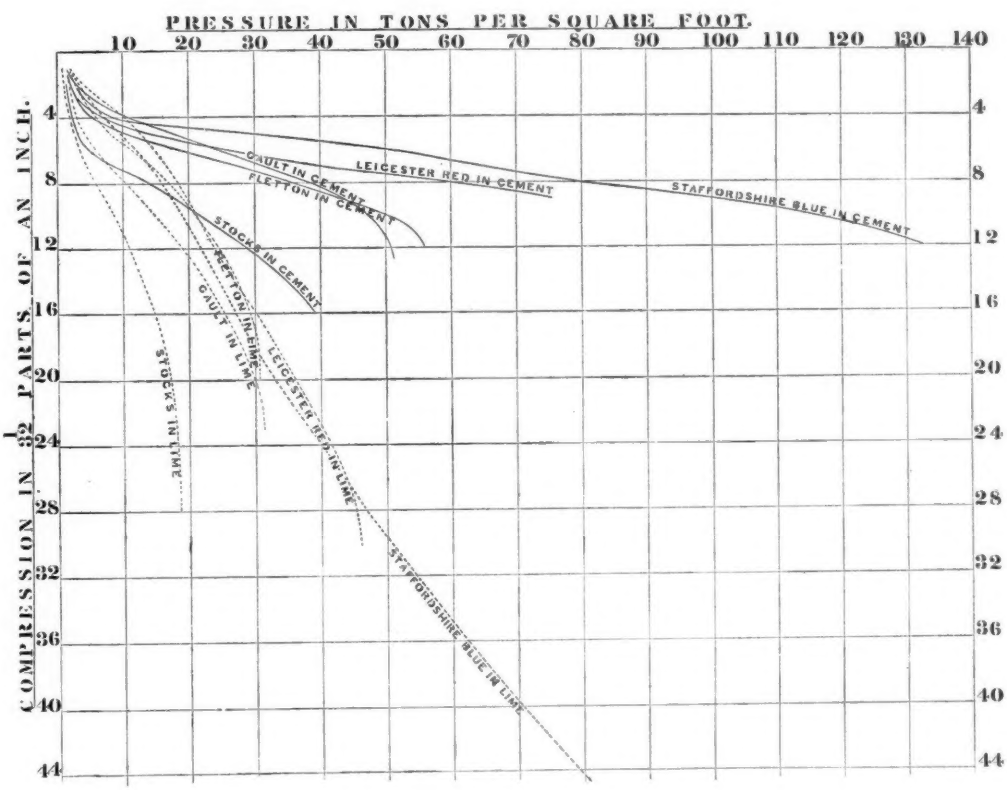
Wall 6′ 0¾″ high; 27″ × 18″; sectional area 3·375 sq. ft.
Built 13th November; crushed 7th April. Age 20$\frac{6}{7}$ weeks.

Time	Pressure on gauge. Pounds per square inch	Total real pressure in tons	Pressure per square foot of wall in tons	Compression in inches	Notes
2.36	15	4·26	1·26	—	In bearing.
2.37½	18	5·65	1·67	$\frac{2}{32}$	
2.42½	25	8·90	2·64	$\frac{3}{32}$	
2.46½	38	14·93	4·42	$\frac{4}{32}$	
2.52	80	34·42	10·20	$\frac{5}{32}$	
2.53½	133	59·01	17·49	$\frac{6}{32}$	
2.59	168	75·25	22·30	$\frac{7}{32}$	
3.10	215	97·06	28·76	$\frac{8}{32}$	
3.17	310	141·14	41·82	$\frac{9}{32}$	
3.19	365	166·66	49·38	$\frac{10}{32}$	
3.21	400	182·90	54·19	—	E. face, hair crack in courses 1 and 2, 1″ from S. end.
					S. end, crack in centre of courses 1 to 7.
3.22	420	192·18	56·94	$\frac{11}{32}$	S. end, crack in centre of courses 1 to 7 extended to course 8.
					E. face, hair crack in courses 1 to 4, 2″ from S. end.
3.24	425	194·50	57·63	$\frac{12}{32}$	S. end, crack extended from course 1 to 9.
					S. end, crack in course 18.
					S. end, crack in courses 5 to 7, 4″ from E. face.
3.40	—	—	—	—	The pressure gauge from this point kept falling till 360, when the wall failed by shearing.
					The N. end remaining intact from course 8 to 24, except a split at centre from top to bottom, open ¼″.

CRUSHING LOADS IN TONS PER SQUARE FOOT.

	Stocks	Gault	Fletton	Leicester Red	Staffordshire Blue
Bricks crushed at	average 84·27	average 189·20	average 220·85	average 362·10	average 779·60
	No.	No.	No.	No.	No.
Brickwork in lime ditto . . .	34. 17·44	36. 31·34	42. 30·82	38. 45·94	40. 118·12
Ditto ditto . . .	35. 19·83	37. 30·94	43. 30·54	39. 44·78	41. 110·56
	— 18·63	— 31·14	— 30·68	— 45·36	— 114·34
	No.	No.	No.	No.	No.
Ditto in cement ditto . . .	44. 39·24	46. 51·50	52. 54·88	48. 80·91	50. 139·52
Ditto ditto . . .	45. 39·34	47. 51·19	53. 57·63	49. 85·78	51. 131·35
	— 39·29	— 51·34	— 56·25	— 83·36	— 135·43

DIAGRAM SHOWING COMPRESSION OF WALLS AT INCREASING PRESSURES.



APPENDICES.

By Professor Unwin [*H.A.*], F.R.S.

DETERMINATION OF LOADS CORRESPONDING TO OBSERVED GAUGE PRESSURES FOR THE LARGE HYDRAULIC PRESS AT THE WEST INDIA DOCKS.

In the third series of tests the press was again tested in the same way as in the two previous series, by crushing copper cylinders. Two cylinders were crushed, but on examination of the compressions I have come to the conclusion that the measured compressions of the second cylinder are untrustworthy. I think there must have been a little bending of the iron packing piece against the head of the framework, to which the compressions were measured. Discarding the tests of the second cylinder, the relation of load and pressure gauge, pressure is almost identical with that found previously.

Comparison of Gauge Pressures, Calculated Loads neglecting Friction, and True Effective Loads of Ram.

Observed gauge pressure	Calculated load on ram neglecting friction	Effective load from compression of copper cylinder	Load calculated by formula	Friction of ram
lbs. per square inch	Tons	Tons	Tons	Tons
50	25·22	20·5	20·5	4·72
100	50·44	43·7	43·7	6·74

The equation connecting the effective load on the ram in tons P, and the pressure gauge pressure in lbs. per sq. in., p, is—

$$P = 0{\cdot}464p - 2{\cdot}7 \quad . \quad . \quad . \quad . \quad (1)$$

It appears that the pressure gauge used was not quite accurate. This does not affect the calculation of the effective load from the compression of the copper cylinders by equation (1). But it does affect the ram friction stated in the table above. The pressure gauge error may explain the apparent variation of the ram friction, or at least part of that variation.

TESTS OF CEMENT AND SAND COMPRESSION CUBES AND TENSION BRIQUETTES.

No.	Description	Date of making	Date of testing	Age in weeks	Dimensions	Area crushed	Crushing Load	Crushing Stress
						sq. ft.		
13	1 of Portland cement + 4 of Special sand by *volume*	13–11–96	10–12–96	4	3″ cube	0·0625	5·520	88·32
15		„ „ „	11–2–97	13	„	„	4·885	78·16
16	1 of Portland cement + 4 of Standard sand by *volume*	„ „ „	10–12–96	4	„	„	2·800	44·81
17		„ „ „	„ „ „	4	„	„	3·410	54·56
18		„ „ „	11–2–97	13	„	„	3·320	53·12

The Special sand was not the same as that used in previous tests. Both it and the cement were samples of the cement and sand used for the third series of piers.

No.	Description	Date of making	Date of testing	Age in weeks	Dimensions	Tenacity
						sq. in.
a	Same mixing as Nos. 16 to 18 above	13–11–96	14–12–96	4	1 sq. in. cross section	114 lbs.
b		„ „ „	„ „ „	4		110 „
c		„ „ „	11–2–97	13		183 „
d		„ „ „	„ „ „	13		174 „

*** The discussion on the foregoing Reports will appear in the issue of 8th January 1898.

9, Conduit Street, London, W., 18*th December* 1897.

CHRONICLE.

The Festival Dinner.

The Festival Dinner in commemoration of the sixtieth anniversary of Her Majesty's accession and of the incorporation of the Royal Institute was held at the Whitehall Rooms on Thursday, the 2nd inst. The company, numbering 155, included several distinguished guests and prominent members of the Institute.

On his presentation to the President in the reception room, Monsieur Poupinel, one of the secretaries of the Société Centrale of Paris, presented a telegram of congratulation from the Society, the terms of which will be found in the report of the President's reply to the toast of "The Royal Institute of British Architects and the Allied Societies."

Before the meal grace was said by the Right Rev. the Lord Bishop of London, and after the meal the *Deum Laudate* (Dr. J. Smith) was sung by Mr. F. Bevan's quartette, who, together with Mrs. Kate Lee, contributed songs during the evening. Owing to the conciseness of the speeches and the promptness of an excellent toast-master, Mr. Farrant, practically the whole programme of toasts and music was got through. The arrangements of the dinner were satisfactory, and, as far as can be judged by very general expression of opinion, the Festival was a success.

The following is a list, in alphabetical order, of the members and guests present on the occasion :—

Professor Aitchison, A.R.A., *President*; Mr. F. W. Albury [*F.*]; Mr. J. Macvicar Anderson [*F.*], F.R.S.E., *Past President*: Mr. C. B. Arding [*A.*]; Mr. W. Wallis Baldwin; Mr. T. Barnes Williams [*F.*]; Mr. Charles E. Barry [*A.*]; Sir J. Wolfe Barry, K.C.B. [*H.A.*], President of the Institution of Civil Engineers; Rev. W. Bazeley; Mr. R. M. Beachcroft, Vice-Chairman of the London County Council; Mr. George Benson, President of the York Society; Mr. Thomas Blashill [*F.*]; Mr. Edward Boardman [*F.*]; Mr. W. R. Bousfield, Q.C., M.P.; Mr. Boyce; Mr. C. W. Brooks [*A.*]; Mr. James Brooks [*F.*], *Royal Gold Medallist*; Mr. H. Brown; Mr. J. M. Brydon [*F.*]; Mr. William J. Bull; Mr. J. J. Burnet [*F.*], A.R.S.A., President of the Glasgow Institute of Architects; Hon. Willoughby Burrell; Mr. W. D. Caröe [*F.*], M.A., F.S.A.; Sir George Hayter Chubb; Mr. T. E. Collcutt; the Rev. Canon Clayton; Mr. J. Collings; Mr. H. H. Collins [*F.*]; Dr. W. J. Collings, Chairman of the London County Council; Professor Corfield [*H.A.*], M.D.; Mr. George Corson, President of the Leeds and Yorkshire Society; Mr. J. D. Crace [*H.A.*]; Mr. H. O. Cresswell [*F.*]; Mr. G. R. Crickmay [*F.*]; Mr. A. G. Cross; Mr. A. W. S. Cross [*F.*]; Mr. Percivall Currey [*F.*]; Mr. Thomas W. Cutler [*F.*]; Mr. T. Raffles Davison [*H.A.*]; Mr. Arthur Dixon; Capt. Donaldson, R.A.; Mr. John Dunn [*F.*]; Mr. William Emerson, *Hon. Secretary*; Mr. Robert Evans [*F.*]; Mr. Robert Evans, jun.; Mr. W. M. Fawcett [*F.*], M.A., F.S.A., *Vice-President*; Mr. H. L. Florence [*F.*], *Vice-President*; Mr. Charles Fowler [*F.*]; Mr. George Frampton, A.R.A.; Mr. Ernest George [*F.*], *Vice-President*, *Royal Gold Medallist*; Dr. Gervis; Mr. Alfred Gilbert [*H.A.*], R.A.; Mr. William Godden, President of the Incorporated Law Society; Mr. William Goldring; Mr. Alexander Graham [*F.*], *Past Vice-President*, F.S.A.; Mr. G. E. Grayson [*F.*]; Mr. E. A. Gruning [*F.*], *Vice-President*; Mr. Albert L. Guy [*A.*]; Mr. W. W. Gwyther [*F.*]; Mr. Axel H. Haig; Mr. Edwin T. Hall [*F.*]; Mr. F. H. A. Hardcastle [*A.*]; Mr. Thomas Hardy; Mr. W. H. Harrison [*F.*]; Mr. James Hine [*F.*], President of the Devon and Exeter Society; Mr. George Hornblower [*A.*]; Sir Henry Howorth, K.C.I.E., M.P.; Mr. F. C. Hunt; Mr. E. B. I'Anson [*F.*]; Mr. Benjamin Ingelow [*F.*]; Mr. Lewis H. Isaacs [*F.*]; Mr. H. O. Jenkyn; Mr. George Judge [*F.*]; Mr. Zeph. King [*F.*]; Sir Stuart Knill, Bart.; Mr. G. F. Lambert; Mr. F. Layland-Barratt, High Sheriff of Cornwall; Sir James D. Linton [*H.A.*], P.R.I.; the Right Rev. the Lord Bishop of London; the Right Hon. the Lord Mayor of London; Mr. W. Ellison Macartney; Sir William MacCormack, President of the Royal College of Surgeons; Mr. E. H. Martineau [*F.*]; Mr. H. E. Milner [*H.A.*], F.L.S.; Mr. James A. Morris [*F.*]; Mr. Andrew Moseley [*F.*]; Captain Moseley; Mr. E. W. Mountford [*F.*]; Herr H. Muthesius, Architect to the German Embassy in London; Mr. James Neale [*F.*]; Mr. John Norton [*F.*]; Mr. Christopher Oakley, President of the Surveyors' Institution; Mr. A. E. Lloyd Oswell [*F.*]; Mr. H. A. Pelly [*A.*]; Mr. F. C. Penrose [*F.*], F.R.S., *Past President*, *Royal Gold Medallist*; Mr. H. R. Perry [*A.*]; Mr. Horatio Porter [*A.*]; Monsieur J. M. Poupinel, Secretary of the Société Centrale des Architectes Français; Sir Edward J. Poynter, P.R.A.; Mr. Hampden W. Pratt [*F.*], President of the Architectural Association (London); Sir W. B. Richmond [*H.A.*], R.A.; Sir G. Scott Robertson, K.C.S.I.; Mr. Marshall Robinson [*A.*]; Mr. T. R. Ronald; Mr. E. O. Sachs; Mr. W. H. Seth-Smith [*F.*]; Mr. George Sherrin [*A.*]; Mr. John Slater [*F.*], B.A.; Mr. H. B. Smith; Mr. Hugh C. Smith, Governor of the Bank of England; Mr. J. Osborne Smith [*F.*]; Mr. P. Gordon Smith [*F.*]; Mr. A. Saxon Snell [*F.*]; Mr. H. Saxon Snell [*F.*]; Mr. Lewis Solomon [*F.*]; Mr. Henry Spalding [*F.*]; Mr. N. J. Stanger [*A.*]; Mr. H. Heathcote Statham [*F.*]; Mr. R. S. Stokes; Mr. William Strang; Mr. W. H. Strudwick; Mr. A. W. Tanner [*A.*]; Mr. Henry Tanner [*F.*]; Sir John Taylor [*F.*], K.C.B.; Mr. Lewis W. Thomas; Sir E. Maunde Thompson, K.C.B., D.C.L., Principal Librarian of the British Museum; Mr. Arnold Thorne [*F.*]; Mr. W. H. Thorp [*F.*]; Mr. Silvanus Trevail [*F.*]; Colonel Waller, R.E.; Mr. Frederick Wallen [*A.*]; Mr. Paul Waterhouse [*F.*], M.A.; Mr. T. H. Watson [*F.*]; Mr. Aston Webb [*F.*], F.S.A., *Past Vice-President*; Mr. William White [*F.*], F.S.A.; Mr. Alfred Williams [*F.*]; Mr. W. E. Willink [*A.*], President of the Liverpool Society; Mr. W. S. Witherington [*F.*]; Sir Henry Trueman Wood, Secretary of the Society of Arts; Mr. H. A. Woodington [*A.*]; Mr. William Woodward [*A.*]; Mr. Charles H. Worley [*F.*]; Mr. R. Selden Wornum [*F.*]; Sir George Young, Bart.; Mr. W. J. Locke, *Secretary*, and other members of the Institute staff and representatives of the press.

The PRESIDENT, PROFESSOR AITCHISON, A.R.A., in giving the toast of "The Queen," observed that nothing he could say would increase the love and reverence they all felt for the head of the Empire. It was owing to Her Majesty's judgment and sagacity that the country was now enjoying peace and plenty, and that every channel of the State was almost choked with golden sand. They had to thank her for the benevolent interest she took in every member of her mighty empire, and that above all she had by her example made virtue fashionable; for it was by virtue alone that empires flourished and continued. The Institute of British Architects was particularly grateful to the Queen for having given into their hands the choice of a worthy recipient of the Gold Medal Her Majesty was graciously pleased to bestow annually on the great architect of the day, to whatsoever country he belonged, and had thus bound up the Institute with the architectural glory of every other civilised nation.

In proposing the next toast, "The Prince and Princess of Wales and the rest of the Royal Family," the President said that with such a mother to imitate they could not be surprised that His Royal Highness and his consort, and the other members of the Royal Family, had won the heart of everybody, as they had always been in the forefront of every proposal for the good of the people and the embellishment of the country. They were ever found ready to sacrifice their time and lend their aid to further every benevolent, useful, or patriotic scheme, from the maintenance of hospitals to the dedication of the Tate Gallery to the nation.*

MR. J. MACVICAR ANDERSON, F.R.S.E., *Past President*, proposed "The Houses of Lords and Commons," and in doing so said he would refer to the Houses of Parliament as ancient edifices; and as ancient edifices those buildings called forth their reverence and their affection. Unfortunately, there were those who had no sympathy with the light and shade that time alone could impart, and which gave the greatest charm to such edifices. Referring to the House of Lords, he said that only the previous day he had heard of a dear old tower, attached to a church in Cornwall, which was threatened with destruction. There were those who had no appreciation for ancient work. One Goth had subscribed 1,000*l*. on condition that the tower should be removed and a modern one put in its place; other sums had been given on similar conditions; and, worst of all, the vicar or rector of the parish—he who of all others should be expected to preserve such an ancient landmark—aided and abetted them. If the tower were removed, its place would be taken by some lofty Babel tower, a monument alike of the conceit and ignorance of its promoters. Such vandalism, he hoped, would be prevented. There was a well-known law in architecture as to obtaining a due and just proportion of window and wall space in an edifice, and he thought that even the most ardent admirers of the House of Commons must admit that the oratorical voids in that assembly have assumed an enormous disproportion to the wall spaces of useful work; but notwithstanding these and other influences of time, they must all hope that these ancient edifices would withstand the ravages of future centuries. With the toast he coupled the names of the Bishop of London and Mr. W. G. E. Macartney, M.P.

The RIGHT REV. THE LORD BISHOP OF LONDON, in the course of his reply for the House of Lords, said it was pleasing to think that a society of architects had resolved itself into a society for the protection of ancient buildings. He then briefly and humorously referred to some of the advantages of a second Chamber, and concluded by saying that so long as the House of Lords rendered advice in measures inaugurated by the House of Commons—so long as it did that, with the gravity and wisdom, consideration and attention to business, which characterised its proceedings, it deserved and received the approbation of the country.

MR. MACARTNEY, in responding for the House of Commons, said that that body occupied one of the lasting monuments of the genius of British architecture, and he trusted that in the future, as in the past, those who had the privilege of conducting the affairs of the nation in that magnificent palace would be inspired by the great traditions which no doubt occupied the attention of the Institute of British Architects, and which ought always to influence the representatives of the nation.

MR. ASTON WEBB, F.S.A., *Past Vice-President*, then proposed "The Lord Mayor and Municipal Corporations." As architects they welcomed the Lord Mayor because he and the Corporation held a power over matters which very much interested architects. With the Corporation lay the power to realise to a great extent the ideal cities which architects naturally had in their minds—cities with broad streets bright and clean, with trees and parks and open spaces; cities well drained, supplied with wholesome and pure water; cities with happy populations as far as laws could make them so; and cities (and here as architects they were specially concerned) which possessed buildings of a municipal character which added distinction to the city or town in which they were placed—buildings in which painting and sculpture had combined with architecture in making them all that art could make them—buildings which strangers would come from far to see, and which should represent, as much as art could, the beauty and dignity of city life. It was work of this kind that Lord Mayors and Municipal Corporations had in hand.

* For the report of the speeches which follow, the Institute is indebted to the excellent report of the Dinner, given in *The Builder* of the 11th inst.

The LORD MAYOR, in the course of his response, said that the Royal Institute of British Architects was commemorating the sixtieth anniversary of Her Majesty's accession and of the incorporation of the Institute, and that afternoon they had been celebrating in the City the anniversary of one of the grandest old buildings in London—viz., the two hundredth anniversary of the opening of St. Paul's Cathedral—a building which was, perhaps, the greatest monument to any man who ever followed the profession of an architect. By their character, past Lord Mayors had built up the Corporation of the City of London, and was there any reason why they should be swallowed up by the County Council? They were an old-established Corporation, and they would be glad to see the County Council become a similar institution, but that could only be accomplished in the course of time; and, in the interval, the Council would be better occupied with the business of the County of London rather than in attempting to destroy the old City of London. As a consequence of the great fire in the City, it was equally important to the City as to the great profession to which they belonged, that something should be done in order that such a catastrophe might not occur in future. He hoped that the Corporation would shortly be able to make some suggestions in regard to the matter, and if any members of the architectural profession could give him any hints on the subject he should be happy to lay them before the Corporation.

The PRESIDENT proposed the toast of "Art, Literature, and Science." He gave Art first for many reasons; but it was only necessary to name two, viz., that it was the first of the fine arts that appealed to man before Literature or Science existed; and, secondly, because it was that form of beauty that nature offered freely to the eyes of every one who was not blind, and she offered this for man's solace, purification, and delight. All writing, from the Egyptian hieroglyphics to the Chinese, was shorthand from pictures. We saw in the painted bas-reliefs of Egypt and Assyria that history, that catalogue of great national events, was given by a series of pictures. Everything that nature offered to our eyes was sculptured and painted, and these coloured forms produced for us the beautiful, the lovely, the sublime, and the terrible; so that, by the various emotions they raised, our souls might not perish through stagnation. In all civilised countries whole classes of gifted men devoted themselves to the portrayal of these evanescent scenes of beauty, sublimity, or terror; and they did more when man was the subject chosen for their chisel or their brush, for they not only portrayed his form and action, and gave us ideals of beauty, of swiftness, or of strength, and of those forms that denoted the possession of courage, wisdom, benevolence, or malignity, but re-created for us the stirring scenes of the past. Among these artists the architect was enrolled, though he was like the chariot drawn by the divine and earthly steeds, and had to combine the useful with the sublime. In this he was assisted by the sculptor and the painter. They had that night with them the President of the Royal Academy, who took the visual fine arts under his wing. Though Literature was a later creation than Art, it had thrust itself to the forefront, for it had time and thought in its hands, and had associated music and melody with itself. No fine art could invade another's domain, for, could one die out, all the rest would not supply its place; a beauty might have her form immortalised by the sculptor, but the painter alone could give her colour. The useful prose had borrowed some of the adornments of her elder sister, poetry, and gave melody and rhythm and eloquence, while in the depiction of conflicting emotions it rivalled poetry itself; still it was to our poets we must look for immortality, for in poetry was concentrated the pith of thought crystallised and polished. He knew not if we could claim equality with the past, in the masterpieces of the visual fine arts, but we might do so with the poetry. Our poets, too, have given "Jewels five words long, that on the stretched forefinger of old Time sparkled for ever." They had with them that night the keeper of all the best poetry and prose that had come down to them since literature was invented, Sir E. Maunde Thompson, of the British Museum. Lastly, he came to Science, or rather to those who had turned the discovered laws of nature into man's obedient servants; and in that respect Great Britain was better off than with poetry. They did not know that all the world estimated Shakespeare, Milton, Burns, Shelley, and Tennyson as we did, but it would hardly deny them the discoveries of Watt, of G. Stephenson, of Arkwright, and of Wheatstone. He did not want to be insular, and it would ill become them to forget Edison, who had given them the electric light. The chemist, the mechanician, and the engineer had revolutionised the world for them. Puck's boast that he could "put a girdle round about the world in forty minutes" had been outdone by the telegraph; and did not the engineers "rift the hills and roll the waters, flash the lightnings, weigh the sun"? He thought he might safely say that from the scientific discoveries of the last hundred and fifty years mankind were better fed, clothed, and housed than they ever were before, and that they were more numerous, more healthy, and longer lived. If life be happiness, the sum of happiness had been vastly increased. They had with them as a representative of science a distinguished engineer, Sir J. Wolfe Barry, whose Tower Bridge they all knew.

SIR E. J. POYNTER, P.R.A., replying for Art, said it was a large subject, and he did not feel equal

to giving that elaborate disquisition on the subject which the President seemed to expect from him, especially as he would have to deliver shortly an address on the subject in another place. Nor would he indulge in commonplaces and platitudes on the advantages of art as an education. He would rather turn to the alliance of the arts of painting and architecture as exemplified in the old friendship between their President and himself, which began when he was a boy in Rome, and was strengthened and cemented by the admiration which they held in common for their late President, Lord Leighton, who was at that time a youth of twenty-three, and full of his first enthusiasm in that passionate devotion to art which was the object of his life. Their President had extended his friendship and kindness to him all through his (the speaker's) life, and he could not say how much he had profited and how much he owed to him. Their President had always entertained exalted views as to the dignity of art, and he had never failed to express them. In the name of the painters and sculptors, he thanked the Institute for the high compliment they had paid them.

Sir E. Maunde Thompson, K.C.B., responded for Literature. He said he had more acquaintance with the outside than with the inside of books, and he could almost weep when he paced down their long corridors at the British Museum and saw the charnel-house of literature all lying on their shelves, and no one referring to them. His only consolation was that the paper upon which they were printed was so abominably bad that final dissolution must come and save posterity from a monstrous amount of literature. But there was yet another consolation. Although there was this great mass of literature pouring into the world in the present day, we were not bound to read it. He was at the head of a great institution, which was not only a library but a repository of art, and he wished to express his thanks to the President for the many kindnesses they had received at the Museum from him whenever there was any question of arrangement in their collection of antiquities.

Sir J. Wolfe Barry, K.C.B. [*H.A.*], in responding for Science, said that as the son of an architect who must have been one of the original members of their Institute, and a President; as the brother of one of their past Presidents, and brother of one of their past Vice-Presidents, it gave him much pleasure to be present that evening, and to be called upon, as President of the sister Society, the Institution of Civil Engineers, to reply for Science. The particular branch of science with which he and they were connected was applied science, and that science had been well described as the handmaid of art. It was a servant, useful, sturdy, and trustworthy, but like such servants in ordinary domestic life (who possessed those qualities) it was not to be trifled with. The science they had to deal with in their profession had its sanitary branch, which was of great importance to the health of the world, as statistics of the duration of life showed; and another branch of the application of science was that known by the word "constructional," which involved making the most of those new discoveries in various kinds of materials and various means of executing buildings, which, of course, appealed to architects who had to deal with new problems of a very different kind from those which were dealt with by the ancients, from whom architects obtained their great principles of art. As time went on, the newer developments of science in the way of construction would have more and more to take their proper place in the art of architecture. Another application of science which called for great attention in this great City, was that which had been alluded to by the Lord Mayor, namely, in trying to make large blocks of buildings less susceptible to the ravages of fire than was the case at the present moment. A few days ago he visited the scene of the great City fire, and one could not help being struck with the fact that there must be something very faulty with the construction of modern buildings that they should fall down and be destroyed in a few hours from a fire which, he supposed, if it had been attacked in the first half-hour, would, under proper modes of construction, have had no great danger to any surrounding houses. He thought he was right in saying, therefore, that architecture had much to learn from science, and that science had something to learn from art. He could not see why things which were useful and served a distinctly utilitarian purpose should necessarily be ugly. He thought that engineers might with very great advantage study some of those great principles of beauty with which architects were more particularly concerned. He recollected that his father used to impress upon him that the great principle of a well-designed and beautiful structure was great attention to proportion. He thought that engineers in the present day might very well consider whether some of our bridges, stations, and other structures might not be a little more beautiful than they are.

Dr. Collins, Chairman of the London County Council, then gave the last toast, viz., "The Royal Institute of British Architects and Allied Societies." He cordially reciprocated the sentiments of the Lord Mayor in saying how close should be the association of municipal enterprise and architecture. Before the year 1834 architecture had no learned Association or Royal Society to represent it. The Charter of the Institute was granted in 1837, and they were celebrating that night their sixtieth anniversary. No doubt great progress had been made since

1837, and the Institute had had as members those whose names would long survive. The speaker then referred to the close contact of architects with the London County Council, referring to the London Building Act of 1894 with its 218 clauses, and the Tribunal of Appeal which was instituted by that Act. The London County Council recently required the assistance of an architectural critic upon the work of the Works Department, and a gentleman of ability had been found in the person of Mr. Gruning. He would also take that opportunity of saying how much London owed to Mr. Blashill, the Superintending Architect of the Council. In that connection he might refer to the careful supervision, under the direction of Mr. Blashill and the District Surveyors, of the stands, &c., which were erected for the sightseers at the time of the Queen's Jubilee. Alarming prophecies of catastrophe had been made in connection with that event. The County Council had a keen regard for the preservation of buildings of historic interest and architectural value. At a recent conference, to which the Institute sent representatives, they considered how best to preserve such buildings, the existence of which they learned only when they were threatened with destruction. It was suggested that they should make a register of historic buildings, and they were now seeking powers to that end. He must congratulate the Institute upon the high repute in which it was held. It was, he believed, the only recognised architectural body which was incorporated under Royal Charter, and he was glad to know that there were some five Presidents of the Allied Societies with them that evening. They must all think, as they walked through the principal streets, that, after all, there was a vast amount of ugliness and prosaic quality about our public buildings, and, no doubt, they sometimes asked how it was that with such an array of architectural talent things were not better than they are. The Institute was an examining body, and the teaching of architecture was the province of the Architectural Association, the Royal Academy, the National Art Training School, and one or two other institutions; but it was a matter of agreement, he thought, that architecture was not at the present time taught in London in a manner worthy of the city. He had often wondered why architecture had not received that recognition in our Universities which it ought to have done. They heard so much of the humanities; but, after all, were not literature and architecture humanities; the exquisite in form, that which was implicit in thought? Architecture, as a German philosopher had described it, was frozen music—harmony crystallised into form; and he (the speaker) thought it should find some place in our University examinations. He was not sure whether it was too much to dream of a Municipal School of Architecture in London, and he would be glad to use any influence he might possess with the University of London to adopt such a measure.

The PRESIDENT, in reply, said that of all the fine arts practised in London there was none that was less thought of than architecture. He would ask them to consider architecture in two of its phases, its obtrusiveness and its permanence. Painting and sculpture might be put into a room or cupboard, but architecture met people everywhere, and surely that was a reason why a city should be made beautiful and not ugly. Then in regard to the enduring character of architecture, although it was true that large and important buildings might be destroyed by invaders, by natural convulsions, or by neglect, yet if these two former did not occur and care were taken they lasted for centuries. In spite of the lapse of time, of fire and earthquake, they had still the remains of the Parthenon at Athens—a building which caused the perennial admiration of those who were sufficiently educated to understand its beauty. Then there were the remains of architectural splendours of Rome and elsewhere; but in his opinion insufficient notice was taken of the claims which architecture made on the admiration and gratitude of mankind. Architecture taught many lessons and excited many emotions that could be raised by it alone. No one who had visited the interior of the Pantheon at Rome could have forgotten the impression of its proportions, size, and lighting. It was the work of a great genius whose name had been lost, and it affected thousands, and had done so from its creation. It was consequently a matter for the consideration of the architect to see if his genius and his study would enable him to produce something equal, though not like, such a building as the Pantheon. He thought it was the duty of every patriot in the country to endeavour to make the city he inhabited beautiful. It must be remembered that the great works of architecture that he had referred to must be visited, for they could not be exported for the benefit of people in other lands. The Institute had done what it could to improve the education and to raise the aims of the young architect. He wished that more could be done, but the difficulty was to know how to do more. Every man who embraced the profession should endeavour to make himself as capable as possible, and should regard architecture not as a mere means of making a livelihood, but something by which his country might be distinguished. He might say that the excellence and progression of their great profession are more dear to him than anything that could happen to himself. They must recollect that Aristotle considered architecture as one of the master arts of the world. In regard to the street architecture of London, M. Paul Sedille expressed, in a book he wrote about the architecture of England, the opinion that its domestic works were

admirable. He hoped and believed that genius would spring up to make the larger and more important buildings equal to those of any other country. The greatest hope and desire he had was that the next century should produce works of architecture in England which would vie with the great works of Greece, Rome, the Middle Ages, and the Renaissance. He thought it was because architecture had got into the wrong groove that they did not succeed in producing work of the greatest excellence, and until that were remedied we should never proceed very far. The only people about whose progress in architecture we knew anything were the mediævals, and he could not help thinking, although he was opposed to imitation, that nothing could be better than the methods those people followed, and that if we tried to follow their methods architecture would again proceed on its way. They had with them that night two gentlemen from abroad, viz., Herr H. Muthesius, who had come to this country to study our architecture, and one of the secretaries of the Société Centrale of Paris, Monsieur J. M. Poupinel, who had just handed him a telegram which he had received from his Society to the following effect:—"We pray you to present our most sincere and most cordial felicitations to the Royal Institute of British Architects on its sixtieth anniversary." The telegram was signed by the Vice-Presidents, MM. Hermant and Lucas, and the Principal Secretary, M. Boileau. No doubt they would desire to send their sincere thanks to the Society for the great interest they had taken in the Institute and for their congratulations.

The proceedings then terminated.

The Belgian Society and the Institute.

The following letter of congratulation, addressed to the President and Members of the Institute from the Société Centrale d'Architecture de Belgique, is here printed by order of Council:—

Bruxelles, le 6 décembre 1897.

Messieurs,—La Société Centrale d'Architecture de Belgique me charge de vous présenter ses félicitations bien sincères à l'occasion du soixantième anniversaire de votre illustre Société.

Elle vous prie d'agréer, Monsieur, l'expression de ses meilleurs sentiments de confraternité.

Le Président,
V. Dumortier.

The late Octavius Hansard [*F.*].

Mr. Octavius Hansard, whose tragic death at Portland Road Station came as a great shock to all, had been a Fellow of the Institute since 1860, and for very many years was a member of Council. Born in 1826, he was the eighth son of Mr. Luke Graves Hansard, printer to the House of Commons. He studied architecture at the Royal Academy Schools, then in Trafalgar Square, having as a fellow-pupil the late Lord Leighton, with whom he always maintained friendly relations. He began the new buildings for Messrs. Marshall & Snelgrove in Oxford Street in conjunction with the late Sir Horace Jones, and on the death of Sir Horace completed them alone. Mr. Hansard was only married so recently as the 9th November last to Miss Ruth Fenton. He was a younger brother of the late Rev. Septimus Hansard, rector of Bethnal Green, in whose parish he always took a great interest. He was buried in Brompton Cemetery on Thursday, the 9th inst. The President, the Hon. Secretary, Mr. Alex. Graham, and the Secretary attended on behalf of the Institute, and many members were present at the grave. Feeling allusion was made to the deceased by the President at last Monday's Meeting.

The late John Loughborough Pearson [*F.*], R.A.

The death of Mr. J. L. Pearson was announced by the President at the last General Meeting in the following terms:—"I have also, unfortunately, to announce the death of our distinguished Fellow and Gold Medallist Mr. J. L. Pearson, R.A. He died on Saturday morning last, after a short illness, at the age of 81, just on the verge of old age, and at work almost to the last. All of us who have known him—and I do not think there are many here who have known him longer than I, for I made his acquaintance in 1855—must have felt that he was a fine specimen of the English gentleman. Many must have known his kindness of heart, his amiability of temper, his courage, his vigour of mind and uprightness, those qualities that so distinguish the finest samples of our race. But I must not let the enumeration of his noble qualities divert us from paying our due tribute to his distinction as an architect, and to the great works that he has done. I think I may say without fear of contradiction that he was the most distinguished of our ecclesiastical architects. His works are spread all over our country, and we know many of his works in London that have brought him into fame. When I first had the pleasure of knowing him in 1855, through the introduction of Mr. Burges, he had just built the church at Vauxhall, which I believe contained the first brick vaulting on stone ribs that had in modern days been done in England. I think I may say that we all admire those great works that he has done. Many of us have seen his restorations at Lincoln, at Peterborough, and at the Abbey, and some of us have had the good fortune of seeing his cathedral at Truro. A gentleman of the Roman Catholic persuasion said a few years ago 'that of all the modern English cathedrals the only one that was fit for a Roman Catholic cathedral was Truro.' He was always ready to give his advice to any of his professional brethren, young or old, who desired to take advantage of

his knowledge and large experience. It will be unnecessary for me to enlarge, for everybody who knew Mr. Pearson must have loved him; and all those who did not know him, but have seen his works, must have admired his genius and the great quantity of work which he produced. I beg you all to join me in a vote of condolence to his family for their irreparable loss. His death is almost as great a loss to us as to his art and to the world."

Exigencies of time will not permit more than a reference to the funeral of the late Mr. Pearson, which took place on the 16th inst. at Westminster Abbey. The Institute was represented in the procession at the Abbey by a deputation from the Council, and many members were present at the service.

A Graceful Compliment from Stockholm.

An architectural work of folio size, illustrated by numerous clever and expressive sketches of detail, has just been presented to the Institute, through Mr. A. H. Haig, by the artist, Mr. Agi Lindegren, to whom the book itself owes so much; and it is presented in so noble a form, and with such an exceptionally artistic dedication, that the donor could not have given a more generous or sincere evidence of his desire to pay a high compliment to his brother architects in England.

Not only is the volume beautifully bound in full red morocco, finely tooled and gilt, having a device of the royal arms of Sweden on the side, but the dedicatory page is enriched by a fine rendering of the device of the Institute, illuminated in colours with admirable artistic spirit and with great refinement of detail. It is surely seldom that a handsome contribution is made to our Library with so charming a grace; and every member of the Institute who examines the work itself will not fail to be grateful for so delightful an expression of compliment and goodwill. The book is a description of the Palace of Drottningholm, the Swedish Versailles, with some account of its history, by Dr. John Böttiger, the actual title being as follows:—

"Hedvig Eleonoras Drottningholm Anteckningar till Slottets Äldre Byggnadshistoria af Dr. John Böttiger, Intendent för H.M. Konungens Konstsamlingar, ny upplaga illustrerad af Agi Lindegren, Slottsarkitekt ä Drottningholm.—Tryckt i Stockholm hos P. Palmquists Aktiebolag, 1897."

The Palace of Drottningholm (Queen's Island), it may be added, is on a beautiful island of the Lake Mälaren, and distant but seven or eight miles from Stockholm. The foundation of the existing building was laid by Hedvig Eleonora, widow of Charles X., towards the end of the seventeenth century; and the building has been handsomely fitted internally by succeeding sovereigns. The gardens are finely laid out in the old French manner, and ornamented by sculpture both in marble and bronze. J. D. CRACE.

Miscellaneous.

DEATH has deprived the Institute of five members since the last issue of the JOURNAL. Their names were announced at the General Meeting of Monday, the 13th inst., and will be found in the Minutes of the Meeting.

THE length of space occupied by the Brickwork Papers compels postponement of publication of the discussion thereon until the next issue. The speakers included, besides those mentioned in the Minutes, Mr. P. Gordon Smith, Mr. H. Heathcote Statham, Mr. William White, F.S.A., Mr. Bruce J. Capell, and the President.

MR. Alfred Waterhouse [*F.*], R.A., LL.D., has been appointed Treasurer of the Royal Academy, *vice* Mr. J. C. Horsley, R.A., resigned.

IT may interest readers of the JOURNAL to know that Colonel Lenox Prendergast's review of "The Castle of Vincigliata" (JOURNAL, Vol. IV., p. 440) has been translated into Italian, and published in Florence in pamphlet form.

A CIRCULAR letter is being issued from the Council to Metropolitan architects on the lines of Mr. Woodward's proposals [p. 64] with reference to the London County Council's proposed amendments to the London Building Act.

THE publication is announced of *An Architect's Experiences, Professional, Artistic, and Theatrical*, by Mr. Alfred Darbyshire [*F.*]. [Manchester: J. E. Cornish.]

AT the distribution of prizes at the Royal Academy, on the 10th inst., two *Students R.I.B.A.* were among the successful competitors, viz. John Stevens Lee, who won the £10 premium (Lower School) for a set of drawings of an architectural design (subject, a Lych Gate), and Arthur Maryon Watson, to whom was awarded the First Silver Medal for a set of Measured Drawings of the Library at Lambeth Palace.

REVIEWS. LXIII.

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PHILÆ.

A Report on the Islands and Temples of Philæ. By Captain H. G. Lyons, R.E. With an Introductory Note by W. E. Garstin, C.M.G., Under-Secretary of State for Public Works Department in Egypt. Printed by order of Hussein Fakhri Pasha, Minister of Public Works. Fo. 1897.

The proposition to overwhelm the Island of Philæ, with its group of temples, and to drown a length of not less than one hundred miles beneath the waters of an enormous reservoir, need only be

referred to: the subject has been fully discussed in these columns. The ambitious scheme as first proposed has been very much modified; indeed, whilst maintaining, as it does, that a reservoir is necessary at the First Cataract, the Department of Public Works in Egypt, under the able guidance of Sir W. E. Garstin, has shown itself most willing to listen to and to consider the objections which have been laid before it. We cannot do better than quote the "Introductory Note" to the report, written by Sir W. E. Garstin himself, which is the subject of this review:—

> I have no intention here of entering into the question of the conflicting interests of agriculture and archæology, as involved by the construction of the above work. It will suffice to say that the technical advisers of the Egyptian Government, after due consideration of the protests lodged against the proposal by the scientific societies of Europe, eventually recommended that a modification of the original scheme should be adopted. The project, as modified, was so designed that, while assuring to a portion of the country the benefits resulting from an increased water supply in summer, it should at the same time secure the celebrated monuments of the Philæ Island from any chance of destruction.
>
> The main point of difference between the two schemes lies in the fact that in the modified project as now accepted, the water surface level in the reservoir has been reduced by eight metres (27 feet) below that originally decided upon. By this alteration the greater portion of the ruins on the island will remain permanently above the submerged level. Some parts of the structures must unavoidably be flooded for a short period of each year; but before the reservoir is constructed, steps will be taken to secure their stability, and to preserve them from decay.

The book now under review is the result of the investigations then set in hand and placed under the charge of Captain H. G. Lyons, R.E. "Captain Lyons, besides being a highly trained Engineer, is an Egyptologist of considerable repute, and has moreover already made his name known by his contributions to our scientific knowledge in Egypt."

The book opens with a report—of sixty-eight pages by Captain Lyons, in which we find a general description of the work and the methods employed, a description of the island, a list of the buildings thereon, a report on the foundations of these buildings, and reports in detail upon each temple and building. Then follows a list of repairs which it was found necessary to execute in order to maintain the stability of certain parts; finally, there are appendices, lettered from A to F, entering into most minute details, the whole being assisted by constant references to the photographs and plans, &c., which form the bulk of the volume. Following upon the printed matter, we have no fewer than sixty-seven collotype reproductions from photographs of the island and the objects on it, taken not with a view to picturesque results, but so as best to illustrate the report and to give a careful record of each object.

The selection of the points of view has been made with admirable judgment. The photographs Nos. 12, 18, and 48 enable us to realise how much we shall lose should the reservoir, even as modified, be constructed.

The island was not only a place for temples, but it was covered with houses. The idea of creating a desert around a monument is very modern. The Egyptian surrounded his temple or group of temples with a high wall. The houses of the town crowded close up to this, and within it there is good evidence that many more houses were placed, probably for those serving the temple. In other countries there is sufficient evidence to lead us to know that contrast of small buildings with great was fully appreciated.

When Captain Lyons began his work on the Island of Philæ the visitor passed over mounds of dusty débris, seeing only the ruins of the temples before and around him. These mounds were the débris of the houses and narrow streets since laid bare. From any elevated spot we can now look down on the ruins of a little Pompeii, and realise the picturesque jumble which the place must have presented before it fell into decay: the stately quays, the temples and colonnades rising here and there above the crowded houses, the whole culminating on the highest part of the middle of the island in the Pylons of the Temple of Isis, forming a front to the great inclosure wall which shuts in the bulk of the temple, leaving only its Pylon tops in view.

The remains of the houses and of the great inclosure wall are, unfortunately, built of crude brick. It would be difficult to prove the date of these houses, but certainly they are not all Coptic, as the report seems to imply.

It is to be deeply regretted that the word Coptic is used by Egyptologists almost as a term of reprobation, and that objects of Coptic antiquity have generally been treated with the most ignorant neglect. The Egyptologist seems to think that outside his "ology" there is no more to be studied. In the present instance we must be glad that such extreme disregard of an important page in the great book of archæology has been avoided. In the plan of the island (Plan I.) all the houses and streets are carefully set out, and photographs are given of many details. All these structures of crude brick are doomed to perish. Sir William Garstin tries to put the best face on the matter that he can. He says in his introductory note:

> One portion of the remains at present existing upon the island must, I fear, inevitably disappear with the advent of the reservoir; I mean the Coptic village, which being constructed entirely of mud brick masonry cannot possibly withstand the dissolving action of the water. A complete survey and a detailed plan has, however, been made of it, and its position and arrangement will therefore have been recorded. This being done, there are many people who consider that the general aspect of the island will be improved by the removal of this mass of small mud buildings, which hides in a great measure the outlines of the temples and prevents their symmetry and noble proportions from being properly seen.

The temples were not built to be seen in isolation.

This paragraph from Sir William's introductory note brings us face to face with the melancholy fact that the statement, "By this" (modification of the reservoir scheme) "the greater portion of the ruins in the island will remain permanently above the submerged level," is rather what we wish might be than what will be.

A glance at plan No. VII., which gives us sections through parts of the chief buildings on the island, reveals to us but too plainly that the sentence should have been written otherwise; the unadorned truth being that, except the Temple of Isis, there is not a monument on the island which will not, when the reservoir is full, be partly submerged. The picturesque little building of Nectanebo at the south end of the island will stand in fully nine feet of water, leaving little more than the top visible; the great Pylon will stand in six feet of water, the Kiosk in three to four feet of water.

It will be but for a few weeks that the level of the water will stand so high, but, in result, everything that is not of stone will be converted into slime and gently float away; "much improving the aspect of the island," as many people are said to think.

In view of this unfortunate state of things the greatest attention has been paid to examining the foundations of all the stone buildings, and with the most interesting and, upon the whole, satisfactory result. Many of them are found to stand upon the granite of which the island is composed, the foundations carried down, block under block, below the floor level to a greater depth than the buildings they bear stand above the floor level. Other foundations, equally solidly built in themselves, stand on the Nile deposit. It does not seem a difficult problem to secure these from movement; indeed we understand that it is the intention of the Egyptian Government not to admit any water whatever until every structure on the island that can be preserved has been consolidated below and made thoroughly secure above. From the action of the Nile water on the stone we have nothing to fear.

Whilst we are forced to deplore the loss both of interest and charm which must fall upon Philæ and its surroundings, we must not forget that from the earliest times the irrigation of the country has been one of the first cares of those who governed Egypt. The need of irrigation is as great now as it ever has been. Whilst feeling this need the existing Government has with no niggard hand done its best to meet the views of the students of antiquity. Again, to quote the words of Sir William Garstin:—

I trust that Captain Lyons's work and report upon Philæ will be accepted as an earnest of the good faith of the Egyptian Government in the matter of endeavouring to preserve a scientific record of all monuments affected by the construction of the reservoirs. In addition to what has been done at Philæ, the survey of Nubia has been commenced, and the different site plans (with levels) of all monuments existing in the above tract of country will be published when opportunity offers.

This statement was made in June 1896, and already a great deal of work in the direction above indicated has been done.

The report is printed by Messrs. Waterlow & Sons for the Egyptian Government, and they may be congratulated upon the excellence of their collotype reproductions of the photographs. The type and printing are clear, the shiny paper detestable, whilst the outside of the book reminds one of a cheap album for stamps.

SOMERS CLARKE.

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BUILDING CONSTRUCTION.

Building Construction and Superintendence. By F. E. Kidder, C.E. 8o. New York, 1897. [William T. Comstock, 23, Warren Street, New York.]

The first volume of a new work on Building Construction and Superintendence has lately been written by an American architect, Mr. F. E. Kidder, C.E., and presents many novel features which are not usually found in works of this kind.

Chapter I., devoted to foundations and the setting-out of buildings, contains some useful information, from actual American buildings, on designing foundations on firm soils and on superintending this work from an architect's point of view.

Chapter II. is devoted to foundations on compressible soils, showing methods adopted for spreading the weight of buildings. The bearing power of piles is also given, and safe working loads on piles in different soils. We find here, too, the municipal regulations of New York and other cities affecting foundations, also a note as to spreading the weight on foundations by means of concrete on iron tension bars, and a useful table of the proportion and strength of such foundations which have been used extensively in Chicago; mention is also made of the use of steel beam footings. Timber footings are then described, as are also caissons, especially as carried out in the Manhattan Life Building, New York City, of which a section is shown.

Chapter III. deals with masonry footings and foundation-walls, shoring and underpinning. The objections to the inverted arch are pointed out. Then come some useful notes on the thickness and forms of retaining walls, area walls, and vault walls, and the superintendence of foundation work in general. This chapter contains some very useful information, which is further supplemented by a paragraph on dampness in cellar walls, window and entrance areas, and pavements, which show practical means of treating various subjects.

Shoring, needling, and underpinning are described with illustrations. The description of the Chicago practice of lowering the foundations of new buildings when placed against those of old is interesting.

Chapter VI., on cut stonework, is a practical one, and gives illustrations of various examples of cut stonework. The article on stone cutting and finishing is an improvement on the ordinary building construction book, since, as the author very rightly says, "that the architect may specify correctly the way in which he wishes the stone finished in his buildings, it is necessary that he be familiar with the tools used in cutting and the technical names applied to different kinds of finish." Illustrations of these tools are given and methods of working. Then follow some illustrations showing how stone lintels may be aided by iron joists—a construction very necessary in practice, though hardly according to one's ideas of truth in construction. This chapter is one of the best in the book; but the notes on strength of stone masonry are not carefully worded; for instance, in describing the strength of stone piers, they are all described as so many tons, but whether to the foot, or yard, or inch is not stated. In fact, throughout the book there is a laxity in phraseology, which to the average student would be very puzzling.

In Chapter VII., the author's remarks on brickwork may be of use; but he enters into a mistake common to text-books when saying that bricks should be laid in mortar not more than $\frac{3}{8}$ inch thick. One is entirely at a loss to understand what this means, since, if properly executed, joints of $\frac{1}{2}$ inch up to $\frac{3}{4}$ inch look well in the eyes of certain people. If good mortar is used, nothing need be feared. The notes on ornamental brickwork are better than those in most books of the kind, but might well have been carried further. A note as to laying bricks in freezing weather should be mentioned. The author rightly states "that brickwork should never be laid when the temperature is below 32°, and if it is below 40° and liable to fall below 32° at night, salt should be mixed with the mortar and the bricks *heated* before laying." He also makes the statement: "In building large buildings in the winter time, one-third Portland cement should be added to the mortar; then it will not be damaged by freezing." In England, however, when building below freezing point, it is the custom in good work to effect it in Portland cement. Notes as to thickness of walls, joining new ones and old, party walls, cracks in walls, hollow walls, &c., are included in this chapter.

Chapter VIII. treats of architectural terracotta, its composition and manufacture, and the sham way in which it is usually built up on buildings—on a framework of steel.

Chapter IX. is devoted to fireproofing and the materials for this purpose; the descriptions of fireproof floors are done with apparent care. There can be no harm in these floors, but as long as steel joists and coke breeze concrete can be erected in England at little cost above the ordinary combustible floor, it seems that patent fireproof floorings are scarcely wanted. Then follow notes on column casing and on thin partitions.

Chapter X. deals with the question of iron and steel supports to masonry work in what is known as skeleton construction, a type of work of which the average Englishman is as innocent as the babe unborn. Some of the sections showing this mode of construction are in truth appalling, and it is to be hoped will not reach this island.

Chapter XI., on lathing and plastering with wood and metal laths, is brought up to date by the insertion of expanded metal and sheet metal laths. Why this form of lathing is not more generally preferred to the ordinary combustible wooden lath it is hard to say, as it is in every way superior. Notes on interior plastering, exterior stucco works, &c., are given, as also on the material called "staff," which was used for the façades for the Paris Exposition and the World's Columbian Exposition at Chicago.

Chapter XII. is devoted to concrete building construction, and contains some interesting details with regard to its application in several large American structures, notably that in the Hôtel Ponce de Leon at San Francisco.

Chapter XIII., and the last, is headed "Specifications," of which it gives an outline for the several trades. The author ends his first volume with an appendix containing tables of building stones, &c., as used in America.

We notice throughout the book that the formulæ are not expressed with all the clearness one would desire, and probably Mr. Kidder will see his way to remedy this; otherwise we think the book, with the exceptions mentioned, a fair *résumé* from a student's point of view of Rivington's, on which it seems more or less to be founded.

Part II., in preparation, will contain chapters on woods used in building, framing, floors, roofs, &c., joinery, smiths' work, roofing, slates and tiles, painting, and further specifications of the above.

BANISTER F. FLETCHER.

NOTES, QUERIES, AND REPLIES.

Carfax Tower, Oxford.

From J. P. HARRISON, M.A. Oxon., with reference to the review entitled "Two Oxford Guide Books" [*ante*, p. 50], by John Cotton [*F.*]

The result of an attempt to ascertain the approximate date of two rude arches inside Carfax

Tower, which has recently been made, was communicated to the Royal Archæological Institute at their first autumn meeting. The conclusions arrived at may be of use as a basis for more extended research; they are briefly as follows:—

1. The ragstone arches, above referred to, are of precisely the same construction as some which were discovered ten or twelve years back in the east wall of Oxford Cathedral, and believed to be remains of the ecclesiola known to have been built on the site *circa* 727, and ever since religiously preserved from its connection with the history of St. Frideswide, and the fact that it was the first church that is known to have been built in Oxford.

2. Similar ragstone arches, possessing the same structural and distinctive peculiarities, are found at Binchester and other Roman stations, and no doubt served as models for the Saxon masons.

3. Whilst, however, remains of more or less debased types of Roman arches served as exemplars for the Saxons to copy, it would have been long before they could have learned to frame centering like that upon which the Roman masons turned their ragstone arches, but of which there would have been no existing specimens. Consequently the earlier Saxon arches would have been of a very irregular shape, and more or less angular; and this is conspicuously so, both at Christ Church and Carfax.

4. Another feature that helps to distinguish early from later Saxon ragstone work would be the greater width or span of the arch in the line of springing, compared with that between the jambs, owing to there being for some time no projecting or corbelled impost. Oxford, here also, supplies a good example of later ragstone work in a doorway high up in the north wall of the well-known Saxon tower of St. Michael's Church, where there is not only a moulded impost, but a circular arch showing that it must have been turned on centering, the result being that there is much less difference between the width at the springing and between the jambs or pier-walls; and so it remained until the end of the Saxon period proper, when freestone masonry was the rule in all but exceptional cases.

5. A fourth example of the same distinctive early feature found at Carfax and Christ Church, but in a mutilated state, occurs in the present ringing-chamber of the tower of St. Peter's in the East, also in Oxford. It appears to have formed part of a doorway in the north wall, at some height above the old level of the ground, as in the case of the doorways at Carfax and St. Michael's. The length of walling of which it forms part, as often found in very early buildings, has been preserved when the rest of the tower has been rebuilt, or, in part, cased. The ragstone work is better than at Christ Church or Carfax, and may be of ninth century date.

6. As regards late Saxon architecture, Precentor Venables showed conclusively, shortly before his death, that the two Saxon towers at Lincoln, which were for some years supposed to be the two mentioned in Domesday Book as having been built after the Conquest, are not the ones now existing; for it had been ascertained that the two Domesday churches were demolished several hundred years ago for city improvements. There are, therefore, now no dated examples of late Saxon churches to refer to; but there is reason to believe that Mr. J. H. Parker, and others since his time who closely studied the subject, were right in supposing that Saxon architecture at the date of the Conquest was no worse than Norman of the same period, and sometimes even better.

Middle Row, Holborn.

From John Hebb [*F.*]—

One of the first improvements initiated by the Metropolitan Board of Works was the removal of Middle Row, Holborn, a block of sixteen houses which formerly stood in the midst of High Holborn, opposite the southern end of Gray's Inn Road. As early as 1856 (the Board having only been constituted in the previous year), in consequence of the urgent representations of the Holborn District Board of Works, the Board referred the question of the removal of Middle Row to a committee, who were subsequently authorised to obtain an estimate of the cost of effecting the improvement. The architect to the Board, Mr. Frederick Marrable, estimated the cost of the removal of Middle Row, with the necessary paving, &c., at £46,625, and the cost of acquiring the property on the south side of Holborn between Tennis Court and the entrance to Staple Inn at a further sum of £16,309, making a total of £62,934 as the net cost.

The Board, on the receipt of the report of the committee to which the matter had been referred, instructed the solicitor to the Board to negotiate for the purchase of the freehold, good-will, and other interests in the block known as Middle Row; but difficulties were encountered, and the negotiations were abandoned. In 1860 the Holborn District Board pressed the improvement on the Metropolitan Board, and again in 1862 a deputation from the District Board presented a memorial urging the necessity for the removal of the block, to which the Board replied that the suggested improvement would necessitate an Act of Parliament for its accomplishment, and as there were other improvements of a more pressing nature, the Board declined to undertake the removal of Middle Row.

In 1864 the Metropolitan Board of Works instructed their architect, Mr. George Vulliamy, who had succeeded Mr. Frederick Marrable, to make a fresh survey and estimate of the cost of the property required for the improvement, in view

of the probable increase in the value of the premises. Mr. Vulliamy's estimate was £61,152 for the cost of removal of Middle Row, and £20,000 for the cost of acquiring the houses in High Holborn, or a total of £81,152, an increase of 29 per cent. on the former valuation. Mr. Vulliamy, in his report to the Standing Committee of the Board, expressed the opinion that it would not be advisable to touch the property on the south side of Holborn, the ground floors of the houses being let to tenants having valuable business interests, and the upper floors to solicitors of Staple Inn; and he further reported that the new line of frontage between Tennis Court and the entrance gateway to Staple Inn, suggested by Mr. Marrable, would not in his opinion be equivalent to the cost incurred, and that "it would be questionable in point of taste to destroy one of the most picturesque examples of the half-timber style now existent in the Metropolis." Mr. Marrable's new line of frontage would have destroyed the western half of Staple Inn, and it is well that the public should know to whom it is indebted for the preservation of this interesting relic.

The Metropolitan Board obtained an Act of Parliament authorising the improvement, which was carried out at a cost of £66,559 18*s*. 3*d*., and the widened roadway was thrown open to the public on 24th December 1867.

Holywell Priory, Shoreditch.

From W. A. LONGMORE [*F.*]—

Upon reading the interesting account of Holywell Priory, Shoreditch, by Mr. E. W. Hudson, in the JOURNAL, it has occurred to me that he might perhaps like to know that I have in my office [7, Great Alie Street, Whitechapel, E.] the upper part of the figure of a bishop, carved in Purbeck marble, which was found some years ago in digging the foundation of a house in New Inn Yard, probably part of the site of the Priory; unfortunately, the head could not be found, although searched for. The work is well executed, and might possibly be a portion of a monument to the Bishop Gravesend mentioned in the Paper. Mr. Hudson is welcome to examine it if he wishes, or I could send him a photograph of it.

I may also mention that, having frequently to pass that way while the Great Eastern Railway was being constructed, I once noticed two fine stone corbels, with heads of a king and queen, which were being used as spur stones to a gate leading into the works. I visited the place again shortly afterwards, intending to try and obtain these corbels by purchase, if possible; but they had disappeared, and I could learn nothing about them. I should hope that they have been preserved, as they seemed to be fine works. I took them at the time to be intended for Edward III. and his Queen.

MINUTES. IV.

At a Special General Meeting held Monday, 13th December 1897, at 8 p.m., Professor Aitchison, A.R.A., *President*, in the Chair, the Minutes of the Special General Meeting held 29th November 1897 [p. 74] having been taken as read and signed as correct, on the motion of the President it was

RESOLVED, *nem. con.*, that the following Resolution passed at the Special General Meeting of the 29th November be confirmed, viz.—"That in order that the Council of the Royal Institute may remain in office until the close of the last General Meeting in June of the year following that in which they were elected, the following alteration be made in By-law 30—viz. that in the last line but one of the final clause the word 'last' be substituted for 'first.'"

The Special General Meeting then terminated.

At the Fourth General Meeting (Ordinary) of the Session, held at the conclusion of the Special General Meeting above referred to, Professor Aitchison, A.R.A., *President*, in the Chair, the Minutes of the General Meeting (Business) held Monday, 29th November 1897 [p. 74], were taken as read and signed as correct.

The decease was announced of the following members—viz. Octavius Hansard, elected *Associate* in 1848, *Fellow* in 1860; John Loughborough Pearson, R.A., elected *Fellow* in 1860, *Royal Gold Medallist* 1880; William Stephens Cross, *Fellow*, elected 1882; Joseph Battye, *Associate*, elected 1881; Arthur James Forge, *Associate*, elected 1894.

In reference to the death of Mr Pearson, the President having paid a personal tribute to the estimable qualities of the deceased, and referred to his distinguished work as an architect, it was

RESOLVED, that the Royal Institute of British Architects desires to place on record its admiration of the magnificent works of architecture carried out by the late John Loughborough Pearson, R.A., *Fellow*, and to express its feeling of profound sorrow for the loss sustained by the death of so gifted an artist; also that the Institute do offer to the family of the deceased an expression of sincere condolence with them in their bereavement.

The following Associates attending for the first time since their election were formally admitted and signed the Register, viz. James Richard Fleming, Richard Henry Ernest Hill, Percy Morris, and William Stanley Bates.

The following candidates for membership, found by the Council to be eligible and qualified according to the Charter and By-laws, and admitted by them to candidature, were recommended for election, viz.: As FELLOW, Arthur Alderson France (Bradford); As HON. CORR. MEMBERS, Leopold Eidlitz (New York) and Victor Dumortier (Brussels).

THE REPORT ON THE THIRD SERIES OF BRICKWORK TESTS conducted under the direction of the Science Standing Committee having been read by Mr. William C. Street [*F.*], Mr. Max. Clarke [*A.*] followed with a statement explanatory of the method of carrying out the experiments, and calling attention to the practical value of many of the results arrived at, and further, with the aid of limelight views, gave a description of the behaviour of the walls during compression. Professor Unwin [*H.A.*], F.R.S., having delivered some critical remarks on the way the Reports had been drawn up, and given his views as to the teaching of the results, a discussion ensued, at the conclusion of which a vote of thanks was passed by acclamation to Sir Wm. Arrol and Mr. H. F. Donaldson [*H.A.*] for the valuable assistance they had afforded the Committee, and to the members of the Sub-Committee who had directed the operations, and reported and tabulated the results.

The proceedings then closed and the Meeting separated at 10 P.M.